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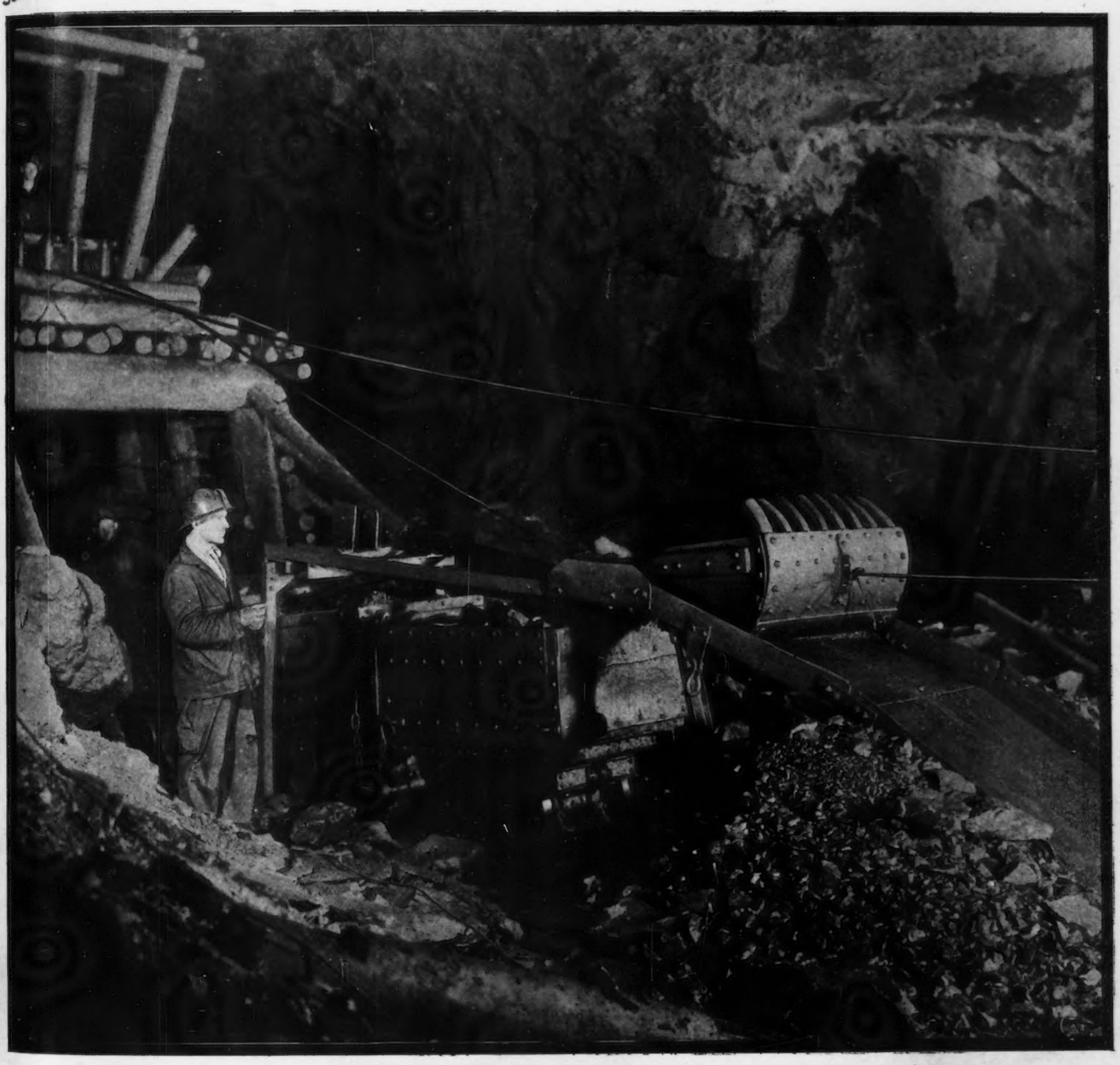
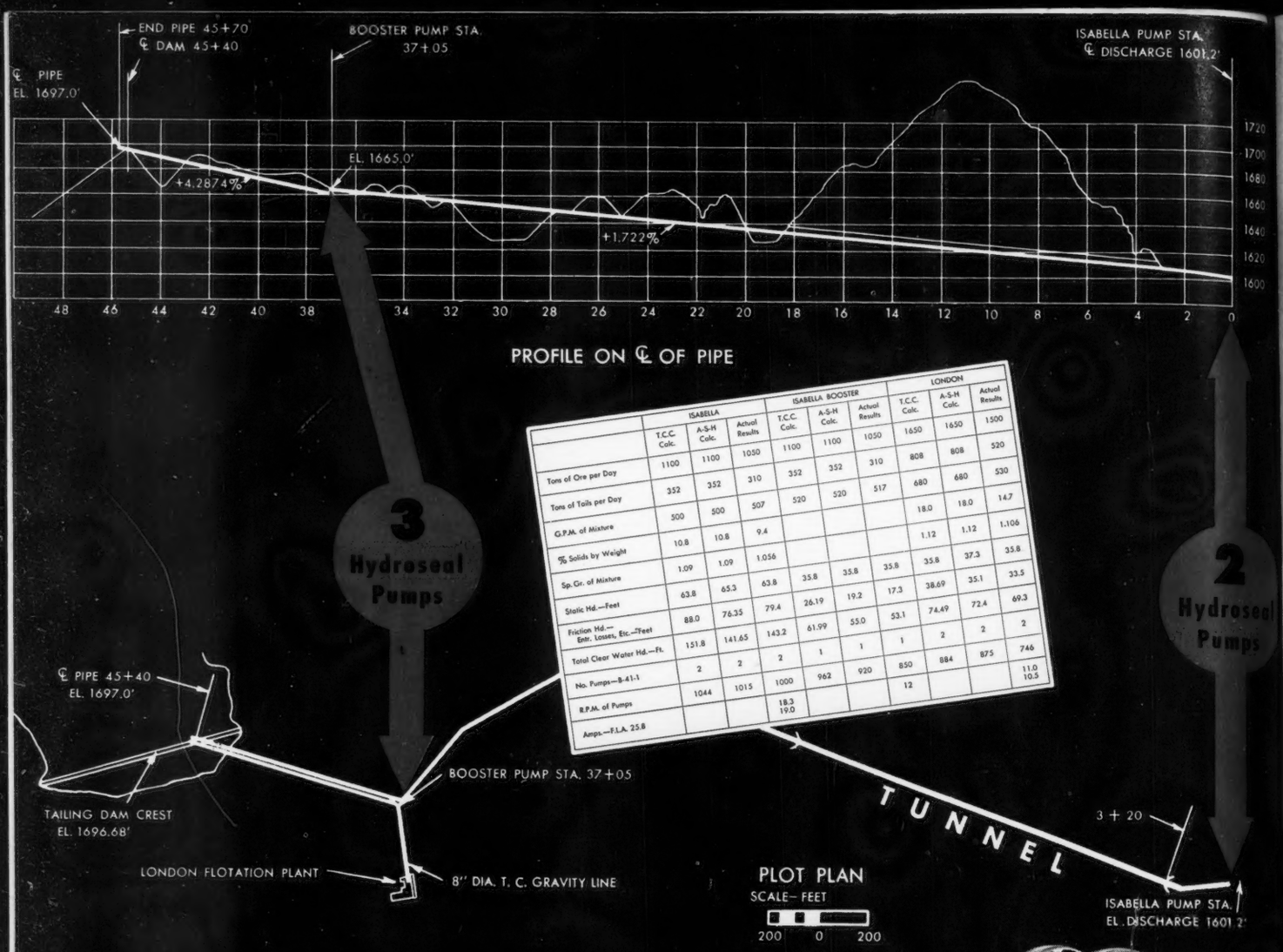


Slide scraper loading at the Soudan iron mine, on the Vermilion Range

SO_2 Leaching of Manganese—Success or Failure? Page 58



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Friction Hd.—Entr. Losses, Etc.—Feet	88.0	76.35	79.4	26.19	19.2	17.3	38.69	35.1	33.5
Total Clear Water Hd.—Ft.	151.8	141.65	143.2	61.99	55.0	53.1	74.49	72.4	69.3
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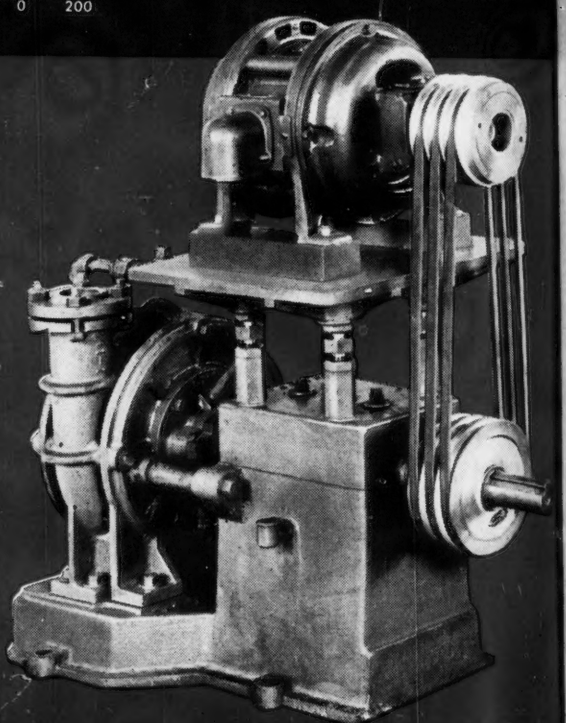

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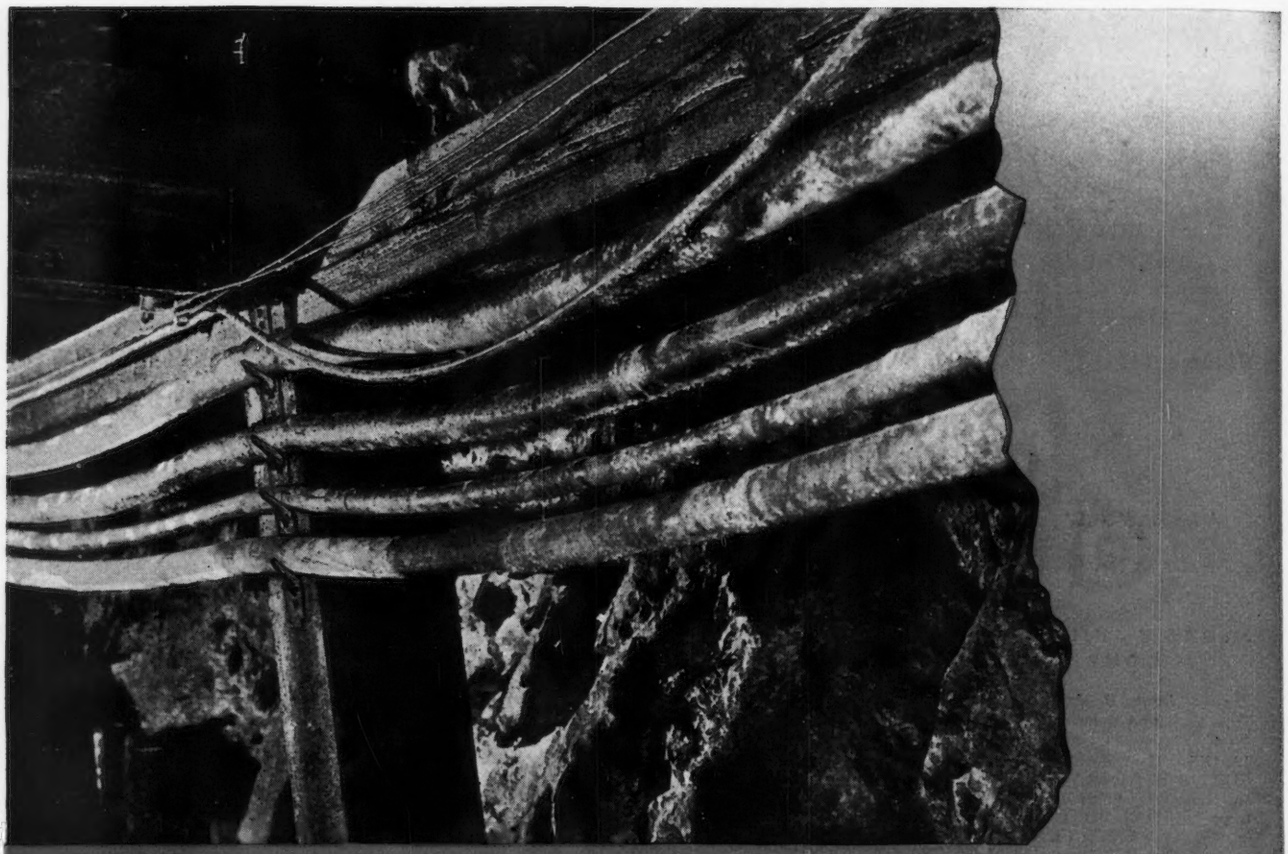

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ENGINEERING AND MINING JOURNAL

JULY, 1946

Public Sold Out Again

THE VETO OF THE CASE BILL was one of the most flagrant sell-outs of the American public by the politicians that our generation has experienced.

Certainly we have had abundant proof that labor leaders and organizations, like every other specially privileged group throughout history, will abuse their privileges for selfish gain, even though they bring the whole country to a state of chaotic anarchy. We have sacrificed the lives of hundreds of thousands of our best young men and expended vast resources to prevent outside enemies from forcing this nation to the helpless state to which the coal mining, railroad, and metal mining unions deliberately brought it, a pattern which the maritime unions were willing to repeat had they not been appeased. Even in the face of a housing shortage which itself constitutes a national emergency, the construction trades have refused to relax their outrageous featherbedding practices or to permit the modernization of building codes.

In the midst of this incredible arrogance and selfish disregard of the general public, Congress stalls on emergency legislation and the President vetoes the Case bill. This bill, far from being designed to wreck unions, simply called for their assuming responsibility for their acts.

It stands out conspicuously that in all the proceedings relative to legislation designed to apply moderate curbs to the special privileges of labor organizations, not a single labor leader did anything but cry havoc and threaten vengeance on those "who would wreck labor unions." Not a single one, even in response to direct questions, had anything to offer on ways and means of controlling the present power of labor unions to wreck our economy if they so desire.

The weak Presidential statement which explained the veto of the Case bill was a model of modern political insufficiency. Obviously, it was framed by callous, party-minded politicians in the Administration with a view to appeasing the labor leaders whose noses were out of joint over the President's belated action in preventing the railroad engineers and trainmen from paralyzing the nation. It begged the whole question of why we are in such a predicament. The proposal for six months of deliberation was a shallow move to get the Democratic party over the fall elections without alienating labor leaders.

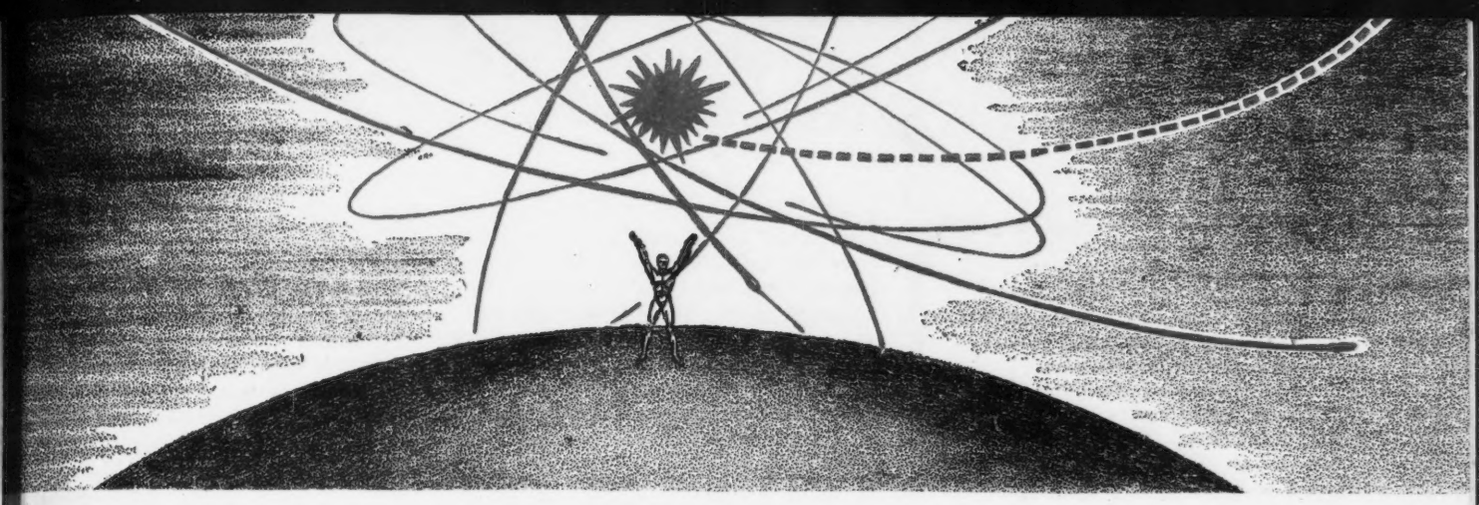
Realizing the short memories of ordinary citizens and the vindictiveness of organized minorities, we can understand why the political professionals framed up this sell-out. We cannot understand, however, why a man who has been accorded the highest honor the American people can grant would sign his name to it.

Apparently, the time has not arrived when labor leaders and organizations will have to accept responsibility, but it is not far off. Another whirl on the wage-price-productionless spiral merry-go-round, and enough of the public will get mad and stay mad to make the politicians take notice. Possibly the reaction will come this fall, when the work stoppages and cost increases of this spring will be reflected in prices. If not, it will certainly come next year, after cost-of-living increases give labor leaders new excuses to halt production and threaten our national existence.

This Time It's Nickel

ON MAY 16 the Department of Justice brought an anti-trust suit against the International Nickel Company, Ltd. The suit seeks to divorce the American subsidiary and its assets from the parent Canadian company. These assets consist principally of a rolling mill at Huntington, W. Va., where much pioneering has been done in the development of useful nickel alloys. The plant constitutes approximately 4 percent of International Nickel's total plant property.

This action is another link in a long chain of misguided actions stemming from the Department of Justice. It is true that Inco is far and away the world's largest nickel producer; nevertheless, there is production from other sources, including Falconbridge at Sudbury, New Caledonia, Finland, and Cuba. Deposits which may produce in due time are in Oregon and Brazil, probably elsewhere. Inco's preeminence in nickel stems from its ownership of the largest nickel deposits at Sudbury, On-



MAN vs ATOM—YEAR 1

WHEREIN WE SIGNALIZE THE FIRST ANNIVERSARY OF THE ATOMIC AGE, CONSIDER THE ALTERNATIVES INHERENT IN BOTH GOOD AND EVIL POTENTIALITIES OF NUCLEAR FISSION, THEN VENTURE A GLIMPSE INTO THE FUTURE

A YEAR AGO, July 16, 1945, at Alamogordo, New Mexico, man created the first atomic explosion. Most impressive events diminish in stature as they recede in time. This one grows bigger with each passing day. It truly marked the beginning of a new age.

As Year 1 of the Atomic Age ends and Year 2 begins, we are engaged in three portentous projects.

At Bikini Atoll we are detonating the fourth and, possibly, the fifth atomic explosions in the history of the world.

At Oak Ridge, Tennessee, we are building the first atomic energy plant for peaceful purposes.

Most important, in New York we and all the other United Nations are engaged in the first attempt to subject atomic energy to international control. Literally, the fate of the world hangs on this attempt.

As this introduction is written, the United Nations Atomic Energy Commission has just begun its work. People everywhere pray for its success—for their own sake, but even more for their children and for their grandchildren. If this Commission fails let everyone everywhere be warned: the world has taken a step toward destruction.

As we enter the second year of the Atomic Age, the nations of the earth are embarked on an atomic armaments race. There is no blinking that fact. We have had official notice served on us. Therefore, we must understand that unless the United Nations Commission can arrest the drift of events, we are moving toward a horrible war. The Commission must succeed.

The American delegate, Mr. Baruch, has brought to the Commission an ably thought out plan. It would internationalize nuclear science, and release for mankind the beneficent applications of atomic energy. But it would "control" atomic bombs only to the extent of giving the world brief warning of any nation's preparation to use them, so that we might have foreknowledge of disaster.

Therefore, the real and enormous task before the world becomes clear. We must end war. No other control of atomic weapons exists. If war comes, atomic weapons will be used. If they are used, our children who survive will curse their fathers. Understanding the consequences of failure, we *must* succeed.

Because we cannot succeed without knowledge, I have asked my associates at McGraw-Hill to condense into the following pages what we know at the close of Year 1 about this great new atomic force — its basic science, its possible uses and its political repercussions.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Co., Inc.

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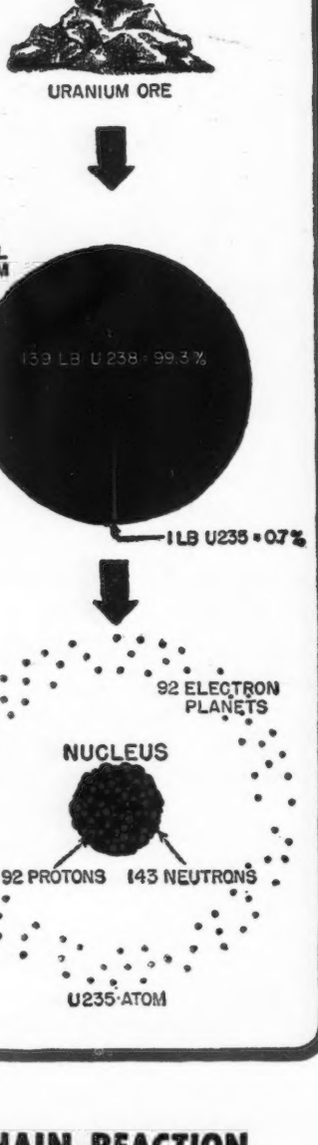
This Fateful Atom . . .

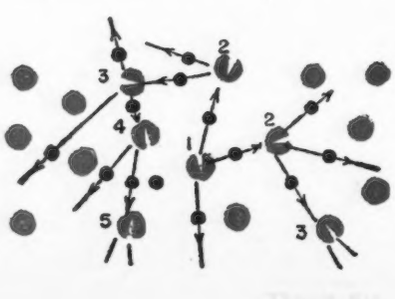
1 ORE TO U235

Only 0.7% of natural uranium is U235



2 CHAIN REACTION

Fragments from earlier nuclear explosions smash other nuclei



LOOKING BACK twelve months to the birth of Year 1, Atomic Age, we begin to sense the majestic import of the atomic bomb that blasted the naked desert at Alamogordo, N. M., on July 16, 1945. There man first shattered atoms in an explosive *fast-chain* reaction. Then came Hiroshima and Nagasaki.

In every case the fateful atom was either uranium 235 (U235), or plutonium derived from the action of U235 on U238. Every pound of U235 atoms split in these unprecedented blasts yielded the energy of 11.4 million kilowatt-hours, or 1400 tons of coal — slightly more for plutonium.

No matter where one mines uranium ore, the purified natural uranium (Fig. 1) always contains 99.3% of the "garden" variety U238, and a mere 0.7% of the precious U235.

An atom is like our solar system. The central sun is the nucleus — a bunched mass of protons and neutrons, each weighing one unit. The planets are electrons. Each proton has one plus electrical charge — each electron an equal negative charge. There must be as many negative electron planets as positive protons in the nucleus. This is also the "number" of the atom. Neutrons have no charge, but add weight.

The atomic number of uranium is 92 because the uranium atom always has 92 nuclear protons and 92 electron planets. The isotopes U238 and U235 differ only in the number of neutrons; U238 has 146 neutrons, and weighs $92 + 146 = 238$ units. U235 has 143 neutrons, and weighs $92 + 143 = 235$ units.

Ordinary chemical reactions, such as TNT explosions, release only a fraction of the modest energy of the whirling electrons in the outer atom. Nuclear reactions unlock the immensely greater energies which bind together the nucleus.

Even the gentle tap of a slow-moving neutron bullet will split the atom of U235 or of man-made plutonium into two medium-weight atoms, yielding also one to three spare neutrons plus energy. Thus these *fissionable* materials supply both their own bullets and a highly sensitive lot of high-explosive targets — a perfect setup for a *chain reaction* (Fig. 2).

Chain reactions work like chain letters. Neutrons from one nuclear explosion hit and explode other nuclei. But, since atoms are mostly open spaces a chain started in a small block of U235 or plutonium quickly dies out because most of the released neutrons escape from the block.

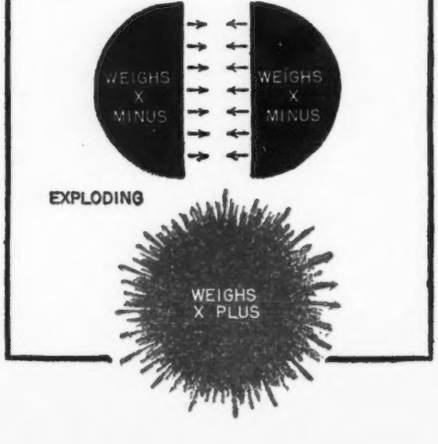
The bigger the block, the smaller will be the percentage of escaping neutrons, and the more left to split other nuclei. When the block is rapidly built up beyond a certain secret size the fragments of 1000 nuclear fissions split many more than 1000 additional nuclei. Then fissions multiply geometrically, and the block disintegrates with explosive speed and violence — as in a bomb (Fig. 3).

This bomb explosion is a fast-neutron chain. For economy and ease of control, uranium piles for the gradual release of nuclear energy for commercial purposes will normally use a lean fuel — that is U235 or plutonium diluted with U238, thorium or other less costly materials.

To maintain a chain reaction such piles must be large and artificially stimulated by using carbon blocks or some other *moderator* (Fig. 4) to slow many of the neutrons. Slow neutrons make more hits than fast neutrons because there is more time for them to be swerved from a straight path by the attraction of nearby nuclei, as shown below.

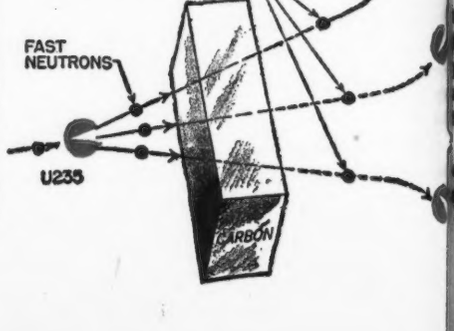
3 WHY BOMB EXPLODES

When block of rapidly assembled U235 passes secret critical size it explodes spontaneously



4 SLOW NEUTRONS MAKE MORE HITS

A slow neutron is more easily swerved from a straight line



...can Serve Man...

THE FATEFUL U235 ATOM can serve man as a new, compact source of heat energy for power generation, comfort heating or industrial processing. Peacetime applications of atomic energy will use dilute U235 or plutonium as a "fuel," mixed with carbon or some other moderator to slow some of the neutrons and thus keep the chain reaction going.

The diluting agent may be either U238 or thorium, or both. These will do double duty, because neutron bullets convert U238 into the energy-yielding plutonium, and thorium into U233, which may prove equally serviceable.

Thus the commercial piles of the future will "burn" U235 to make other atomic fuels, plutonium and possibly U233, which in turn will deliver heat energy to the pile. In that way it will be possible to get from the pile far more heat than the equivalent of 1400 tons of coal for each pound of U235 split. This highly attractive prospect will speed the day when nuclear energy can compete with coal.

While already mechanically obsolete, the piles making plutonium for bombs at Hanford, Wash. (Fig. 1) reveal the basic principle on which future piles for power and heat will operate. The heat now wasted in vast quantities will be put to work. The plutonium, now removed for bomb manufacture, will be returned to the pile (or left in) as supplementary fuel.

ATOMIC POWER

The possible everyday applications of nuclear heat pictured in Fig. 2 have been recognized from the very first day of the Atomic Age. Year 2 will see the building of the world's first atomic power plant (a pilot plant) at Oak Ridge, Tenn.

Beyond question such installations will produce power, but it may be years or decades before they prove economical. To compete with conventional plants the piles must first be redesigned to run at temperatures high enough for good power-plant efficiency. Also the techniques of operating piles by remote control through the heavy radiation screens must be radically streamlined.

The Hanford piles run on natural uranium containing only 0.7% of U235. The typical commercial atomic power plant of the future will use more than 0.7% of U235 or plutonium, but less than 50%. This will avoid both the low efficiency of the too-lean mixture and the excessive fuel cost of the rich mixture. It will permit piles of moderate size and take maximum advantage of U238 and thorium as potential sources of plutonium and U233.

One should not expect U235 to replace coal generally in this generation, although a few central power stations and ships will try it out before Year 10 of the Atomic Age. Plants far from traditional sources of fuels may turn much sooner to uranium and thorium as concentrated heat sources, that may easily be transported even to remote corners of the earth.

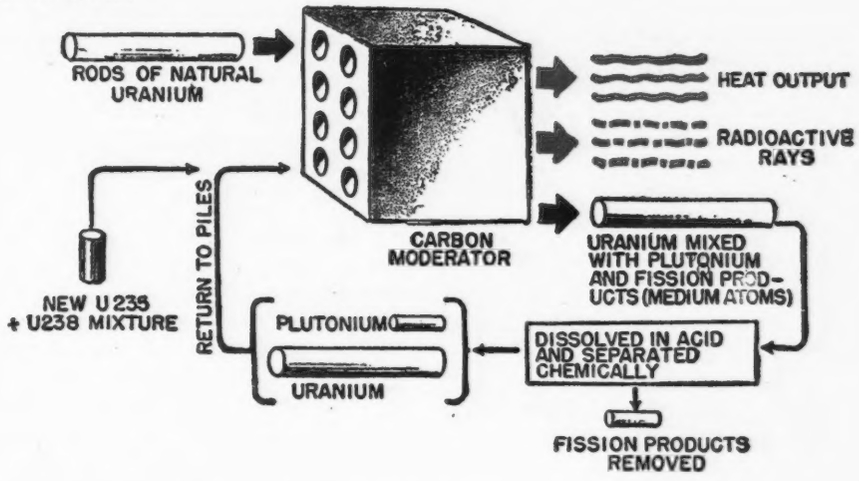
Atomic power, in forms now known, is impracticable for automobiles and small airplanes, because of the large initial investment in uranium and the need to carry 50 tons of shielding to protect riders and pedestrians against the deadly radioactivity accompanying nuclear fission.

RADIOACTIVE ISOTOPES

More immediately important than the heat and power applications of nuclear energy are the services that the radioactive byproducts of pile operation can render. Because these materials act chemically like their ordinary non-radioactive cousins, but can be followed and detected easily, they are expected to play tremendously vital parts in medicine and biology. For more details, see the last page of this section.

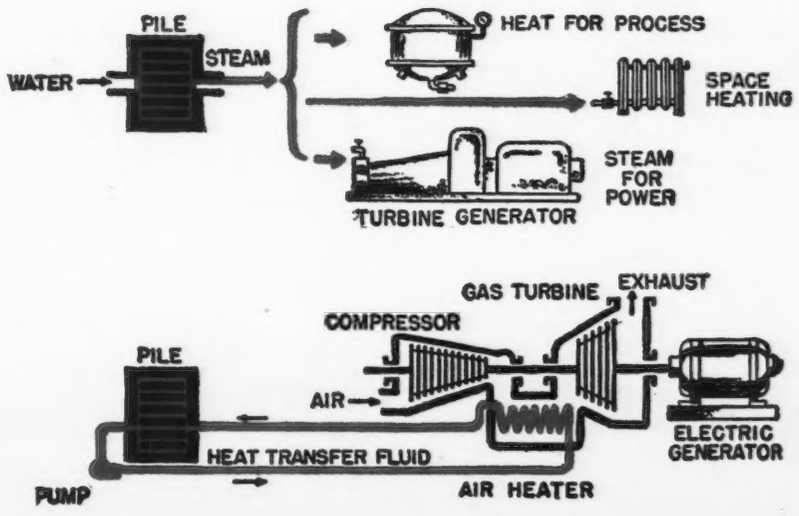
1 SLOW-NEUTRON PILE

Can make plutonium for bombs—or heat for power, process and comfort

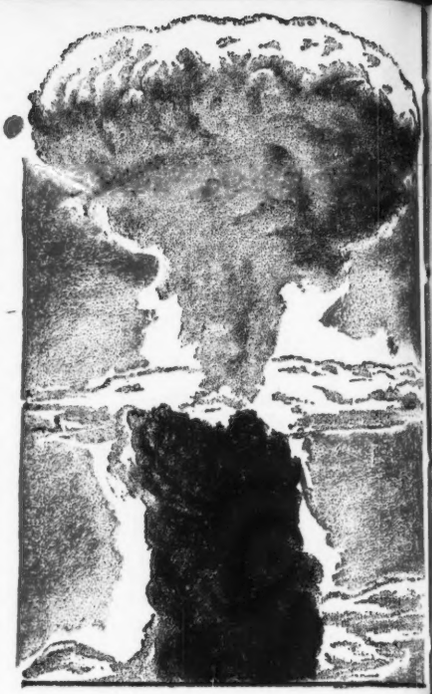


2 PRACTICAL APPLICATIONS

Include steam for turbines, process and comfort heating—also heat for gas turbines



or Destroy him . . .



A single improved atomic bomb can devastate ten square miles of city

URANIUM 235 and plutonium are now man's slaves. They will build or destroy as he orders. Man dreads this vast force only because he distrusts himself. War is proof that man in the mass has never achieved self-control. He has always sought better weapons; yet the perfect weapon now brings him no satisfaction for he sees in the atom bomb his own destruction as well as that of his enemy.

The ultimate benefits of nuclear energy may well surpass its present terrors, but the terrors are here now in awful dimension, and man must face them. He must pay this price for unlocking the wealth of the inner atom.

ATOMIC BOMB

This page, then, is about the atomic bomb. Nothing will be said here that is not either a certified scientific fact or a conclusion shared by the majority of the leading scientists, engineers and statesmen who have studied the matter.

As already explained, an explosive nuclear chain reaction spontaneously sweeps through a block of U235 or plutonium when the block is rapidly enlarged beyond a certain "critical" weight X. That weight is still a military secret; the official Smyth report vaguely suggests that it is more than 4 lb and less than 200 lb. Each piece of U235 in the dormant bomb must weigh less than X. At the desired instant of explosion the bomb mechanism assembles these pieces rapidly into a single piece considerably heavier than X.

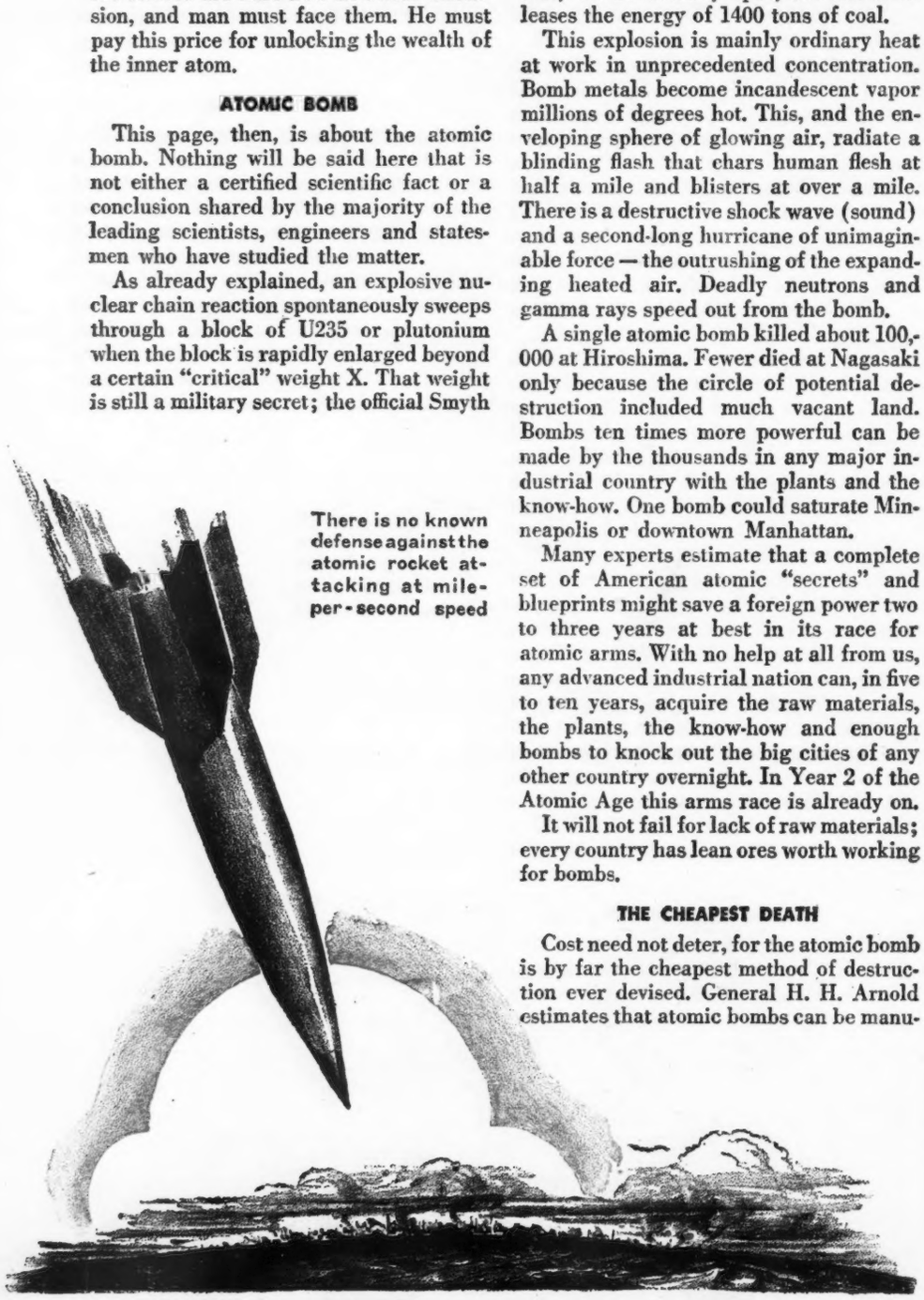
The explosion itself drives the U235 pieces apart, thereby quenching the atomic conflagration before all the atoms are split, so the bomb efficiency is far less than 100%. For each pound of U235 (or plutonium) atoms actually split, the bomb releases the energy of 1400 tons of coal.

This explosion is mainly ordinary heat at work in unprecedented concentration. Bomb metals become incandescent vapor millions of degrees hot. This, and the enveloping sphere of glowing air, radiate a blinding flash that chars human flesh at half a mile and blisters at over a mile. There is a destructive shock wave (sound) and a second-long hurricane of unimaginable force — the outrushing of the expanding heated air. Deadly neutrons and gamma rays speed out from the bomb.

A single atomic bomb killed about 100,000 at Hiroshima. Fewer died at Nagasaki only because the circle of potential destruction included much vacant land. Bombs ten times more powerful can be made by the thousands in any major industrial country with the plants and the know-how. One bomb could saturate Minneapolis or downtown Manhattan.

Many experts estimate that a complete set of American atomic "secrets" and blueprints might save a foreign power two to three years at best in its race for atomic arms. With no help at all from us, any advanced industrial nation can, in five to ten years, acquire the raw materials, the plants, the know-how and enough bombs to knock out the big cities of any other country overnight. In Year 2 of the Atomic Age this arms race is already on.

It will not fail for lack of raw materials; every country has lean ores worth working for bombs.



There is no known defense against the atomic rocket attacking at mile-per-second speed

THE CHEAPEST DEATH

Cost need not deter, for the atomic bomb is by far the cheapest method of destruction ever devised. General H. H. Arnold estimates that atomic bombs can be manufactured *and delivered* for less than $500,000 per square mile of destruction.

Don't be misled by the two billion dollars America spent on a project that dropped only two bombs on the enemy. New plants can be built at a fraction of wartime cost, and the investment spread over thousands of bombs, not just two.

NO DEFENSE

So the bombs can be made in ample quantity and paid for, but can they be delivered? The answer is: "Yes; by the time the bombs are ready they can be delivered anywhere and overnight." If the defenses of the target country are weak, piloted planes can get through in ample number. Ten percent would be enough.

For more effective delivery radio-steered pilotless planes and rockets can carry the atom bombs faster than sound. Such weapons will be almost untouchable by either antiaircraft artillery or manflown fighters.

Greatest threat of all will be the transoceanic rockets. The German V-2 rocket, which never once was stopped by Britain's defenders, points one way. It needs only transatlantic range (with atomic propulsion) and an atomic bomb in the nose. Forty-six feet long, loaded with 7500 lb of alcohol fuel and 11,000 lb of liquid oxygen, the V-2 of World War II rose 60 miles in the air and arced 200 miles in five minutes to deposit one ton of TNT in London.

Seeing so many strange things come to pass, the man in the street cannot distinguish between possible miracles and the impossible variety. From the very start of the Atomic Age he has been hoping for a "ray" that will explode the atom bomb far off. Competent scientists and engineers say that cannot be.

The only way to bring down a 3500-mile-per-hour rocket at a safe distance is to chase it with your own 4000-mph rocket. You can't win at this game often enough to establish ironclad protection.

The only specific defense against the atomic rocket known in Year 2 of the Atomic Age is to disperse all cities and put key industries underground. This would be very costly in time, money and national morale.

MORE AND BETTER BOMBS?

Some will ask whether the U.S., as the most powerful industrial nation, could not build more and better bombs and carriers than any other nation. Probably yes, but there is still no real security. If the "weak" opponent has enough atomic weapons to destroy us once, what advantage is there in being able to destroy him twice?

Shooting first could protect us now, but not after the world is atomically armed. If we were to destroy the enemy's cities, we would probably miss his well-concealed and protected bomb magazines and rocket launchers. A few minutes later he could return the atomic fire. In brutal simplicity, that is the picture of future atomic war. Everybody loses.

At this point one grasps at another straw: "If everybody is to lose who would be so foolish as to start an atomic war? And didn't the Germans refrain from using gas for a similar reason?" Possibly yes. It *may* work that way. But in a world atomically armed to the teeth some nervous finger *may* pull the fatal trigger.

ONLY ONE WAY OUT

Throughout history each new offensive weapon has called out its appropriate defense. But now the offense leaps centuries ahead in a single bound and the defense lies almost helpless everywhere, unless some technical protection, unknown as Year 2 begins, can be devised.

The situation is extremely dangerous. There is no clear way out except through some sort of international action first to stop the atomic arms race and, before it is too late, to hobble war itself.

Can it be done? Perhaps not, but there is no alternative except atomic chaos.

...so he faces the Atomic Dilemma...

THE NUMBERED statements that follow in somewhat logical pattern are too fateful to be accepted on anybody's say-so. Every reader should test them in the light of his own information and understanding.

The points below sum up the conclusions of the previous article — and these in turn reflect a great mass of thought and discussion among leading scientists, engineers and statesmen close to the problem. To an amazing degree they concur on both facts and conclusions. For authoritative statements of their line of thought, in detail not possible here, the reader should see the recent book, *One World or None.*

THE DILEMMA

Nations must either face the probability of an atomic World War III, which would surely be the most deadly in history . . .

***Or,* the experts propose, yield both atomic weapons and war potential to international authority backed by superior force.**

What the Experts Say

1. In five to ten years any major industrial nation can make enough atom bombs to destroy all the major cities of any other country overnight.

2. This assumes no "secret" information or other help from us.

3. The necessary uranium ores will be at hand.

4. The cost will not be too high.

5. The bombs produced can then be carried thousands of miles by bombers, or by atomically powered guided missiles moving faster than sound.

6. There will probably be no effective military defense against such weapons.

7. Dispersing cities, and putting key industries deep underground, will give some protection if accomplished in time, but at incredible cost in money and human discomfort.

8. In a world atomically armed, nations can probably protect their bomb stocks and rocket launchers from enemy assault.

9. If so, nation A can destroy the cities of any other nation B, after which B's rockets will destroy the cities of A. Shooting first will not win an atomic war.

10. This knowledge may not restrain the trigger finger of a suspicious power.

11. Having more and better atomic weapons than the other fellow won't help much if he has enough to destroy us. No use to kill a man twice or rebomb urban ruins.

12. Every nation is vulnerable in the Atomic Age, including the U. S. A.

13. National security will be impossible without (first) international control of atomic arms and (not too long thereafter) international control of all war potential, both backed by superior physical power.

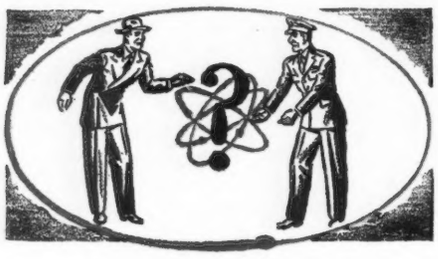
14. If action to this end is long delayed, it may become impossible to halt the atomic arms race already started.

15. At best, the necessary degree of international control, with some real delegation of national sovereignty, will be a revolution in human affairs. It may prove to be humanly unobtainable at this time. If so, men and women everywhere must face the probability of an atomic third world war—by far the most destructive in all history.

In this atomic age no nation can be safe through its own unaided might

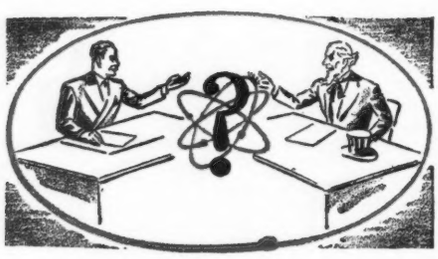
...and the Great Debate unfolds

ATOM YEAR 1 has probably been marked by more debate on a single subject than any other twelve months in the world's history. Social, economic and political as well as purely technical issues have been pressing for realistic solution. Let us look at these issues and see where we stand:



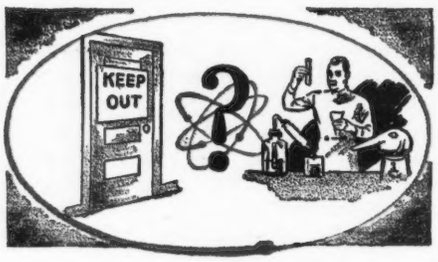
CIVILIAN VS. MILITARY

Because the atomic bomb is the world's greatest weapon, the armed forces would like to control it. But because atomic energy can also be used for peaceful, beneficial purposes, civilian control seems equally essential. These conflicting viewpoints had their strong proponents before the Congress which finally reached a fairly satisfactory compromise in the Atomic Energy Bill of 1946, setting up a competent civil board with which the armed forces will have continuing liaison. As we go to press, just before Year 2 of the Atomic Age begins, this bill has passed the Senate, but there is still a question how rapidly it will be enacted into law.



PRIVATE VS. PUBLIC

Atomic energy is "too big" and "too hot" to be handled privately. It must be nationalized and internationalized. The questions are *how* and *to what extent.* Fortunately, as the "boxes" on these pages show, there are means that may attain reasonable safety against misuse of the atom, and still do so without public control of many "non-dangerous" applications.



SECRECY VS. FREE SCIENCE

Throughout the first year of the Atomic Age hot debate has raged around "keeping the secret of the bomb." To prevent potential enemies from making atom bombs some have urged a complete blackout of all phases of atomic energy — even of the scientific fundamentals of nuclear physics. Others have sought immediate and complete disclosure of all bomb "secrets," both scientific and technological. These have held that such information cannot be effectively hidden, that secrecy blocks progress and breeds wars.

A year of debate has brought the great mass of vocal opinion to this middle ground: (1) Ease restrictions on the exchange of basic physical knowledge. (2) Release for industry's benefit many of the devices and methods developed for the bomb project. (3) Hold tight to specialized information on atomic bombs and bomb-material production until international safeguards are fully operative.

DOMESTIC CONTROL AS PLANNED IN THE ATOMIC ENERGY BILL OF 1946

McMahon Committee Bill contains the following provisions.

Policy. Declares it the policy of the U. S. to develop and utilize atomic energy to improve the public welfare, increase living standards, strengthen competitive enterprise and promote world peace.

Organization. Establishes the Atomic Energy Commission (AEC) of five administrators to direct four divisions on research, production, engineering, and military applications—to work in liaison with three committees from (1) the armed forces, (2) outstanding civilians, and (3) joint Congressional representatives.

Production. AEC to own and operate (under management contracts with industry if deemed desirable) all facilities for the production of fissionable materials, such products to be distributed with their radioactive byproducts under license for private industrial and medical research.

Military Application. AEC to engage in development work and produce atomic bombs as directed by the President, to be delivered only on his order to the Armed Forces.

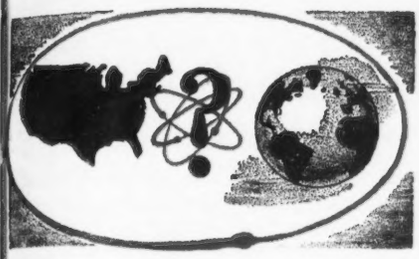
Industrial Utilization. Permits AEC to conduct research, design and manufacture equipment for atomic-energy utilization, license its use, produce and sell power obtained as a byproduct in the production of fissionable materials. Directs AEC to give widest safe scope to private initiative.

Control of Information. AEC to enforce a ban on the dissemination of restricted data that might be used to injure the U. S. or secure advantage to a foreign nation, yet to provide leeway for ultimately relaxing restrictions as future conditions warrant.

Patents and Inventions. No private patents permitted for production of fissionable materials or their utilization for military weapons, but AEC will justly compensate for such inventions, when made by private citizens. Patents for non-military applications may be purchased or condemned by the AEC only when public interest is affected.

Appropriations. "Such sums as may be necessary and appropriate to carry out the purposes and provisions of the act" *plus* unexpended funds of the Manhattan Engineer District.

...while time runs out



NATIONAL VS. INTERNATIONAL

Born of nationalism, the Atomic Age began when three nations discovered a weapon that today gives them the greatest military power on earth. The prime question is: Shall the atom remain the servant of its conqueror, nationalism?

During Year 1 of the Atomic Age the Truman-Atlee-King declaration, the masterly report of the State Department's atomic consultants, and the U.S. representative on the United Nations Atomic Energy Commission, have all called for international control of atomic energy. Year 2 will start with no such control. This failure to decide and act is in part a natural result of the extreme difficulty of the problem and the obvious dangers of unwise decisions. Nations everywhere face a triple dilemma in this Atomic Year 2: the dangers of nationalism, the dangers of internationalism, the supreme danger of not being able to make any decision in time to meet the atomic bomb threat.

INTERNATIONAL CONTROL AS PROPOSED BY THE U.S. TO U.N. ATOMIC COMMISSION

Baruch statement follows constructive path laid out by Atomic Consultants in "Acheson-Lilienthal Report."

The Plan. The U.S. has proposed that all nations band together to outlaw the use of atomic energy for war and to promote and harness its development for the benefit of mankind. To this end an International Atomic Development Authority would be set up, and to it the U.S. would turn over, at various stages of its organization, all atomic bombs, know-how, raw materials, facilities, and stockpiles of fissionable material. Thus IADA eventually would supersede national authorities on some matters and supplement them on others.

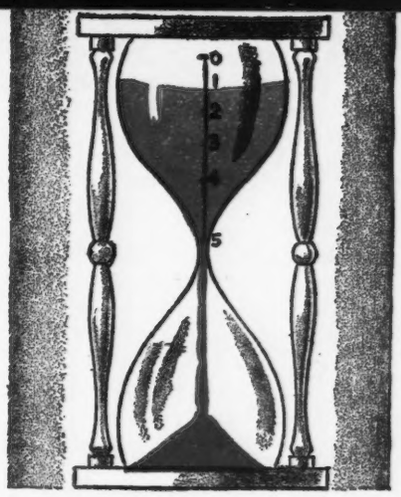
Owner and Operator. IADA would take over from national authorities or private ownership full management and control of all atomic energy matters that afford a possible threat to World security. These include:

1. Raw Materials—Supplies of uranium and thorium to be inventoried, controlled, and developed by IADA.
2. Facilities—IADA to control and operate plants producing fissionable materials and to own and control their products.
3. Research—IADA to undertake research and development on all aspects of atomic energy and to possess exclusive right of research on atomic explosives.

Private Initiative. Will have its chance to push forward the use of atomic energy for peacetime (non-dangerous) purposes. With IADA providing raw materials and carrying out necessary inspection, national and private enterprise may operate "safe" power piles, and produce and use radioactive isotopes for research, clinical and other applications. Radioactive isotopes produced by IADA also can be distributed for peacetime use.

The Mechanics of Safety. No plan is a certain guarantee against future atomic war. This plan should, however, prevent surprise attack with atomic weapons; for IADA is to buttress positive ownership or management controls with wide powers of inspection. Obviously, successful inspection rests on complete freedom of access or egress in any area.

Sanctions. At the heart of the plan lies the problem of penalty for violation — a matter for profound statecraft. To the U.S., one aspect of sanctions appears crystal clear: Here is an area where the veto right now held by the five great Powers must be redefined if it is not to be incompatible with the meaning and purpose of the proposed control.



Leading industrial nations can produce atomic bombs in five years, competent scientists announced after Hiroshima. Already one year of the precious five has been consumed in debate without international action. Soon it may be too late to check the growing momentum of the atomic arms race.

TIMETABLE—ATOM YEAR 1

1. **July 16, 1945.** World's first atomic bomb detonated in New Mexico.
2. **July 26, 1945.** President Truman and Prime Minister Churchill issue Potsdam ultimatum threatening Japan's destruction if she continues.
3. **August 6, 1945.** Atomic bomb dropped on Hiroshima.
4. **August 9, 1945.** Atomic bomb hits Nagasaki.
5. **August 11, 1945.** Army releases Smyth Report on "Atomic Energy for Military Purposes."
6. **August 14, 1945.** Japan accepts terms of Potsdam declaration.
7. **November 15, 1945.** Truman-Atlee-King issue declaration of intention and procedures looking toward international control of atomic energy by United Nations.
8. **March 28, 1946.** State Department issues Acheson-Lilienthal Report on the "International Control of Atomic Energy."
9. **April 12, 1946.** Manhattan Engineer District announces program for experimental development of atomic power.
10. **June 1, 1946.** "Atomic Energy Bill of 1946" passes Senate unanimously, is referred to House of Representatives.
11. **June 14, 1946.** First meeting of United Nations Atomic Energy Commission (Bernard Baruch as American member). Manhattan District announces availability of radioactive isotopes for research use.
12. **July 1946.** Joint Army-Navy tests of atomic bombs at Bikini.

...but if Man Masters Atom

IF MUTUAL DESTRUCTION by the atomic bomb can be avoided, the first century of the atomic age will bring immense advances in scientific knowledge, health and living standards. Already many prospective benefits can be outlined, but those we can neither foresee nor suspect may be even more important.

This prediction is grounded in scientific experience; the most fundamental discoveries have always been the most fruitful. The study of molecules gave us chemistry. Faraday's experiments with electricity and magnetism are the foundation stones of the great electrical industry. Can one expect any less from an understanding of the heart of every atom?

BENEFITS

Atom-splitting benefits clearly visible today fall mainly in three classes: (1) heat and power applications of the uranium piles; (2) general industrial applications of equipment and methods originally developed for the bomb project; (3) chemical, biological and medical uses of the "tagged atoms" (radioactive isotopes) now abundantly available from pile operation.

It is now evident that the energy yield of the U235 in an atomic pile can be multiplied many times by returning to (or leaving in) the pile the plutonium and possibly the U233 produced respectively from the U238 and the thorium in the pile. This is an indirect way to "burn" inexpensive U238 and thorium, and thus greatly extend the supply and reduce the cost of atomic fuels.

POWER APPLICATIONS

Although present piles run at low temperatures, it is certain that temperatures high enough for the efficient operation of steam and gas turbines will be attained. Already an experimental atomic power plant has been ordered. Atomic power for certain remote installations (say, for heating Arctic airports) may not be far off.

In five or ten years uranium piles will be driving a few experimental ships and submarines. In 20 or 30 years uranium may begin to compete widely with coal as a fuel for suitably situated large central heating and power plants. The 50-ton minimum weight of shielding rules out nuclear power for automobiles and small piloted planes.

SPECIAL USES

Some day ultra-high temperatures from splitting atoms will be used for special industrial operations on metals and other materials. Even the dread atomic bomb might easily serve peaceful ends — blasting lakes in deserts, changing the course of rivers, leveling mountains.

INDUSTRIAL BYPRODUCTS

The special industrial equipment and methods developed for the bomb project will find hundreds of important uses — mostly for purposes unrelated to atomic energy. These developments include pumps with neither seals nor leaks, leak detectors of amazing sensitivity, ultratight welding, a portable mass spectograph for quick and automatic gas analysis, new ways of handling corrosive and poisonous materials, new diffusion barriers for the separation of gases and of petroleum products.

TAGGED ATOMS

Yet more important than any of these, in the long run, will be the hundreds of radioactive isotopes now available as by-products of pile operation. Chemically indistinguishable from the ordinary forms of the elements, these isotopes serve as tagged atoms or "spies" if mixed with common stable atoms of the same species. They "fly with the flock," and can later be identified as surely as banded birds. With these amazing tools of research, the course of any element or compound may be traced through the bodies of men, animals and plants. Similarly, tagged atoms may be used in studying the course of many kinds of industrial and chemical operations.

BIOLOGY AND MEDICINE

A suspected hyperthyroid condition can be diagnosed by feeding the patient a minute measured amount of radioactive iodine. The click of a "Geiger" counter placed on the patient's neck will tell (1) what percentage of the swallowed iodine concentrates in the thyroid cells and (2) how rapidly that concentration is accomplished — giving a definite indication of the state of the gland.

In similar fashion the radioactive isotopes of hydrogen, oxygen and carbon will trace out the intricate transformations of carbohydrates and proteins in the human body. Radioactive phosphorus will explore the bones. Radioactive iron will show how and where blood cells are formed. Radioactive sodium will time the circulation of blood.

USES IN INDUSTRY

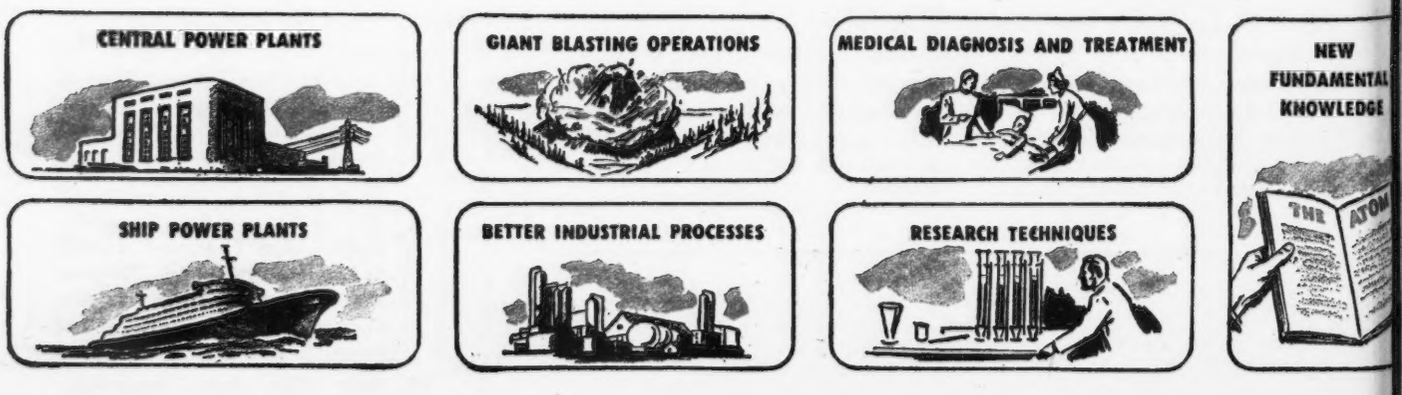
In chemistry the radioactive isotopes will speed the understanding of metallurgical and organic reactions. In industry they will measure flow, detect leaks, and do other useful work.

Meanwhile the uranium piles will be manufacturing certain radioactive isotopes that can serve as cheap but effective substitutes for high-cost medical radium.

KNOWLEDGE COMES FIRST

It is already clear that the chief benefits of atom splitting will come first as new scientific knowledge rather than as new engines and gadgets. But in the long run man's new understanding of the inner atom will enrich the whole range of human activity. This has always been the case with less fundamental discoveries in science. It can hardly be less with this most fundamental discovery.

ATOM SPLITTING WILL SERVE MAN IN:



ENGINEERING AND MINING JOURNAL

JULY, 1946

Public Sold Out Again

THE VETO OF THE CASE BILL was one of the most flagrant sell-outs of the American public by the politicians that our generation has experienced.

Certainly we have had abundant proof that labor leaders and organizations, like every other specially privileged group throughout history, will abuse their privileges for selfish gain, even though they bring the whole country to a state of chaotic anarchy. We have sacrificed the lives of hundreds of thousands of our best young men and expended vast resources to prevent outside enemies from forcing this nation to the helpless state to which the coal mining, railroad, and metal mining unions deliberately brought it, a pattern which the maritime unions were willing to repeat had they not been appeased. Even in the face of a housing shortage which itself constitutes a national emergency, the construction trades have refused to relax their outrageous featherbedding practices or to permit the modernization of building codes.

In the midst of this incredible arrogance and selfish disregard of the general public, Congress stalls on emergency legislation and the President vetoes the Case bill. This bill, far from being designed to wreck unions, simply called for their assuming responsibility for their acts.

It stands out conspicuously that in all the proceedings relative to legislation designed to apply moderate curbs to the special privileges of labor organizations, not a single labor leader did anything but cry havoc and threaten vengeance on those "who would wreck labor unions." Not a single one, even in response to direct questions, had anything to offer on ways and means of controlling the present power of labor unions to wreck our economy if they so desire.

The weak Presidential statement which explained the veto of the Case bill was a model of modern political insufficiency. Obviously, it was framed by callous, party-minded politicians in the Administration with a view to appeasing the labor leaders whose noses were out of joint over the President's belated action in preventing the railroad engineers and trainmen from paralyzing the nation. It begged the whole question of why we are in such a predicament. The proposal for six months of deliberation was a shallow move to get the Democratic party over the fall elections without alienating labor leaders.

Realizing the short memories of ordinary citizens and the vindictiveness of organized minorities, we can understand why the political professionals framed up this sell-out. We cannot understand, however, why a man who has been accorded the highest honor the American people can grant would sign his name to it.

Apparently, the time has not arrived when labor leaders and organizations will have to accept responsibility, but it is not far off. Another whirl on the wage-price-productionless spiral merry-go-round, and enough of the public will get mad and stay mad to make the politicians take notice. Possibly the reaction will come this fall, when the work stoppages and cost increases of this spring will be reflected in prices. If not, it will certainly come next year, after cost-of-living increases give labor leaders new excuses to halt production and threaten our national existence.

This Time It's Nickel

ON MAY 16 the Department of Justice brought an anti-trust suit against the International Nickel Company, Ltd. The suit seeks to divorce the American subsidiary and its assets from the parent Canadian company. These assets consist principally of a rolling mill at Huntington, W. Va., where much pioneering has been done in the development of useful nickel alloys. The plant constitutes approximately 4 percent of International Nickel's total plant property.

This action is another link in a long chain of misguided actions stemming from the Department of Justice. It is true that Inco is far and away the world's largest nickel producer; nevertheless, there is production from other sources, including Falconbridge at Sudbury, New Caledonia, Finland, and Cuba. Deposits which may produce in due time are in Oregon and Brazil, probably elsewhere. Inco's preeminence in nickel stems from its ownership of the largest nickel deposits at Sudbury, On-

tario, and from the impressive technology and plant which the company has built up. It does not stem from monopolistic trade practices. Furthermore, the location of the Huntington plant in the United States is entirely to the advantage of the United States. If Inco should withdraw and duplicate the Huntington facilities elsewhere, not only would nickel products cost American consumers more, but the United States would have virtually no part of the world's functioning nickel plant or technology.

Officials of the company protest that, instead of using monopolistic trade practices to limit uses and raise costs to consumers, they have consistently offered nickel in such excellent products and at such prices that competitors have had to look to subsidies. In other words, they have used their advantages to widen nickel's usefulness and availability, in harmony with the basic aims of our antitrust legislation. Also, the Canadian press has pointed out the great asset Inco's mine and plant capacity, technological excellence, and wholehearted cooperation were to our recent war effort.

We wish we could assure Inco that such a background would protect them against persecution by our political-minded Supreme Court and the Department of Justice, whose zeal amounts to fanaticism when deserving Democrats are not involved. However, Alcoa and Dow nursed aluminum and magnesium technology, markets, and capacity along for years, to the great advantage of the United States when we went to war. All their facilities and technology were freely devoted to the war effort, unmindful of the competition they were setting up for the future, but, instead of gratitude, all these companies got for their pains were shameful persecution and unremitting vilification.

Recently the Supreme Court has decided against the big three in tobacco, on the grounds that, despite furious competition among them, their joint enjoyment of the bulk of the market constitutes "the crime of monopolization."

We believe that the American people support antitrust policies because they do not want monopolistic combines to exterminate competition and then hijack consumers, either as to availability or price. We do not think they consider such organization as Inco, Dow, and Alcoa criminal because their heavy investments in development and technological progress, and outstanding services to consumers, have made competition uninviting. Nor, in our opinion, do the American people want to destroy organizations whose strength has been a national asset in peacetime and invaluable in wartime. Nor, we believe, do they wish to restrain American organizations from meeting foreign combinations and government-backed commerce on an equal footing in foreign fields.

Thus, we think it is high time for a clarification by Congress of our anti-trust policies. It is a Congressional job because Administration action cannot protect the future against publicity-seeking prosecutors, political-minded fanatics, or an incompetent Supreme Court.

Skepticism Over Aluminum Prophylaxis Is Unwarranted

RECENTLY the Council on Industrial Health and the Council on Pharmacy and Chemistry of the American Medical Association issued a statement tending to discourage the use of aluminum therapy in prevention of silicosis (p. 96).

To us, this statement seems irresponsible and destructive. It implies a lack of integrity and caution on the part of the licensor, McIntyre Research Ltd., which is decidedly contrary to fact.

The statement implies that there has not been "prolonged, unbiased observation, with adequate control cases." Actually, aluminum prophylaxis experiments on animals began in 1932 and were carefully conducted for eight years before the method was applied to human beings. Human treatments began in early 1940, with due caution throughout, and six years of experience on human subjects has produced nothing but beneficial results. The benefits have been impressive, and in excess of expectations.

The statement also implies that the use of aluminum prophylaxis might encourage laxity in dust control and treatment of tuberculars. Actually, the reason why the method was patented and has been used under a rigid licensing system was to forestall laxity in dust control or possible carelessness in treating tubercular individuals. McIntyre Research, Ltd., is a non-profit organization, and people who have taken out licenses can testify to the very careful control and frequent inspection exercised by the licensor to prevent laxity or misuse of aluminum prophylaxis.

The statement closes with the recommendation that application of aluminum therapy in industry should be delayed "until adequately and impartially controlled clinical observation demonstrates its effectiveness in preventing or alleviating silicosis in man." Is not six years of careful, ethical, clinical experience in Canada sufficient background, particularly when supported by eight years of extensive animal experiments? It seems to us that the American Medical Association committees have lightly passed over the Canadian experience and have unduly impugned the competency and in-

tegrity of a high-grade and strictly ethical organization to which we owe a large debt of gratitude for making its findings available without profit. Considering the substantial evidence which we have observed in the field of marked benefit from aluminum prophylaxis, including the surprising alleviation of symptoms of silicosis in many cases, we believe that the American Medical Association has done progress in industrial health a disservice.

Must Silver Prices Be Settled by Conflict?

PROBABLY BY THE TIME THIS IS PUBLISHED the silver battle will have subsided into another truce. However, the legislative situation is so complicated that it is impossible to predict the result of the conflict.

We feel it our duty to relay to the producers our belief that the recent political battle over silver has not improved public esteem of silver producers and the Silver Bloc in Congress.

We do not intend to convey an opinion that the 90.3c per ounce purchase price for silver is too high or too low. We do not see how anyone can reasonably predict the course of prices when an inflationary spiral is in progress and its magnitude makes subsequent deflation almost inevitable.

What, in behalf of the silver producer, we witness with reluctance is a price determination made solely by a battle and truce between two political blocs. Again, the majority of the American public gains the impression that silver is nothing but a political racket. Again we have a rash of editorial criticism of the Silver Bloc. Again we have the major foreign, silver-using nations of the world confirmed in their impression that the price of silver has become a football of American domestic politics. It is incredible that these developments will fail to react to the disadvantage of silver producers in the long run.

Now we are informed (p. 96) that the Indian Government is calling in its silver coins to replace them with coins of base metal. A consumer country with a large obligation to repay lend-leased silver in kind is naturally concerned over the new developments. It is bound to take steps to recapture its outstanding silver coins before they go into hiding.

We believe that the silver producer is simply storing up future trouble for himself when he continues to encourage political determination of silver prices. We hold that his long-range interests, like those of any other producer, involve careful consideration of the consumers' problems and attitudes, the consumers in this case being not simply the group of New England silversmiths obeyed by Senator Green, but the users of the world, monetary and otherwise. The present situation, in which producer and consumers view each other as enemies, and in the heat of political controversy are more interested in discountenancing the other's arguments than in learning the economic situation within which the other has to operate, is abnormal and destructive. It contravenes the obvious fact that producer and consumer have as much in common as in opposition. Also, it neglects the viewpoint and problems of the consumers, domestic and foreign, who are not represented by the silver-consumer bloc in Congress. Silver problems, like all others, can be solved better by mutual understanding of the other side's viewpoint than by declaring war on the fellow we cannot do without.

Considering the complicated, international nature of the silver problem, we think that the silver producers would further their long-run interests by engaging in some competent direct fact-finding on a number of issues which are bandied about in controversy year after year. Is the settled postwar industrial market likely to set up such demands for silver that the commercial price will be substantially higher than in recent decades? What new uses for silver are in store and to what extent would these uses be hampered by a high price of silver? Is comparison of the price of ingot silver with prices of finished silverware a sensible basis for discussing silver prices? What amounts of silver would the nations of the world like to use for coinage if they could be assured that the United States Government would not alter its purchase price without regard for their problems? To what extent are governments interfering with the desires of their people to have silver coins and to hoard silver when worried about the future? What governments would be willing to set up silver along with gold as a base for their paper currencies if they did not fear that our Government would upset world silver prices without consulting them? Did the prices paid by our Government in the late thirties cause Oriental governments to sell their silver, or did China, at least, sell silver as a means of financing its long war?

If the silver producers could obtain answers to these questions from an impartial, dependable source, we believe that the knowledge would be valuable in ironing out some of silver's problems. It might not be too much to hope that the producers might sponsor a world conference, where producers, industrial consumers, and representatives of various governments could achieve a better understanding and reduce the present areas of doubt and ill will.

How the SO_2 Process Worked on Three Kids Manganese Ore

D. N. VEDENSKY, Chief Metallurgist, Pan-American Engineering Co., Berkeley, Calif.

KNOWLEDGE OF THE THINGS THAT DID NOT WORK IN DEVELOPING A NEW PROCESS is quite as valuable to other men in that field as a knowledge of the things that were successful, yet too often it is only the latter that are given attention. In this unusual article, Mr. Vedensky tells about not only the successes in Manganese Ore Co.'s work with the new SO_2 process, but the failures as well. As a guide for future work, his report is outstanding.

IN PAST YEARS only a fraction of United States requirements of manganese (about 5 percent in 1939) has been supplied by domestic mines. That is why the threat of war from 1939 on caused the Government some alarm over the prospect of reduced imports of manganese ore.

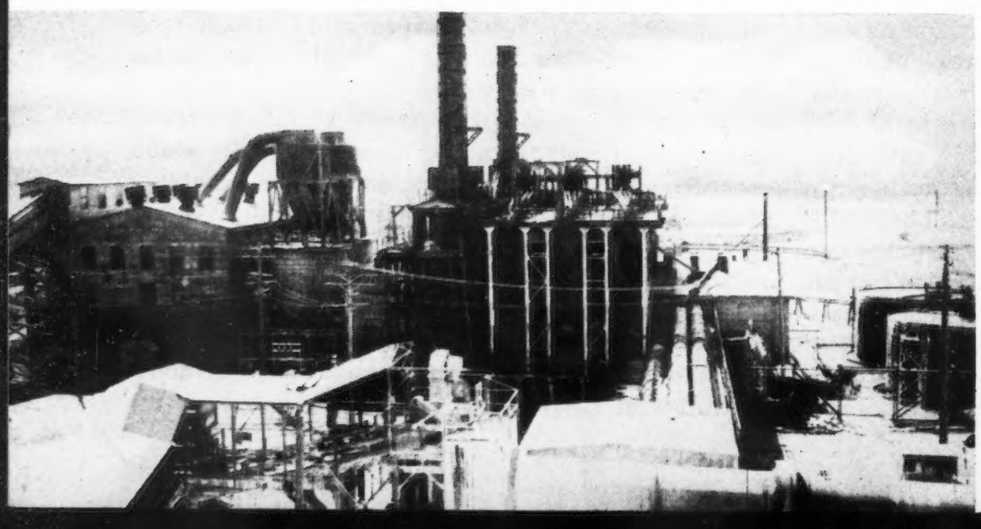
Among other steps taken by the Government was a request in 1940 that the M. A. Hanna Co., of Cleveland, Ohio, concentrate on research to develop a source of high-grade manganese oxide to be blended with low-grade ores to furnish feed for ferromanganese furnaces. The Hanna company not only controlled important domestic reserves of manganese ore, but was also then engaged in research on concentrating them, with particular emphasis on production of electrolytic manganese.

Following thorough study of all available methods of producing high-grade manganese oxide, it was decided to concentrate on further development of the sulphur dioxide process first patented by Van Arsdale and Maier in 1918. The Hanna company began experimental work in January 1941, and later in the year constructed a pilot plant with a daily capacity of 3 to 5 tons of 10 percent manganese ore at the plant of Pan American Engineering Co., Berkeley, Calif., where all investigations were conducted. In continuous operation from October 1941 until late in 1943, this plant served to test ores from the Three Kids mine, near Las Vegas, Nev.; from the Artillery Peak district in Arizona; and from Presque Isle, Me.

After a workable process had been developed, the results were submitted to the Government, and were studied and approved by the National Academy of Sciences. Negotiations then began for construction of a plant near Las Vegas, Nev., to treat 1,000 tons a day of 20 percent manganese ore from the Three Kids mine. Owned by Defense Plant Corporation, the plant was operated by Manganese Ore Co., newly formed subsidiary of the M. A. Hanna Co.

Process flowsheet and plant layout were drawn up by a group of consultants including Messrs. W. L. Badger, Dow Chemical Co.; John D. Sullivan, Battelle Memorial Institute; R. S. Walker, M. A. Hanna Co.; Elliott Underhill, and myself. Basic process drawings were made by Manganese Ore Co. P. J. Walker Co., of Los Angeles, was named contractor to build the plant. The latter firm then engaged Southwestern Engineering Co., Los Angeles, as subcontractor to design plant details.

HIGH-GRADE manganese nodules were produced, as a war measure, in this plant operated near Las Vegas, Nev., by Manganese Ore Co. Low-grade ore was dry-ground in building at left, collected in Cyclones over fine-ore bins, then leached with SO_2 solution in wooden towers in center. Crystals obtained by evaporation were roasted in kiln, feed end in foreground.



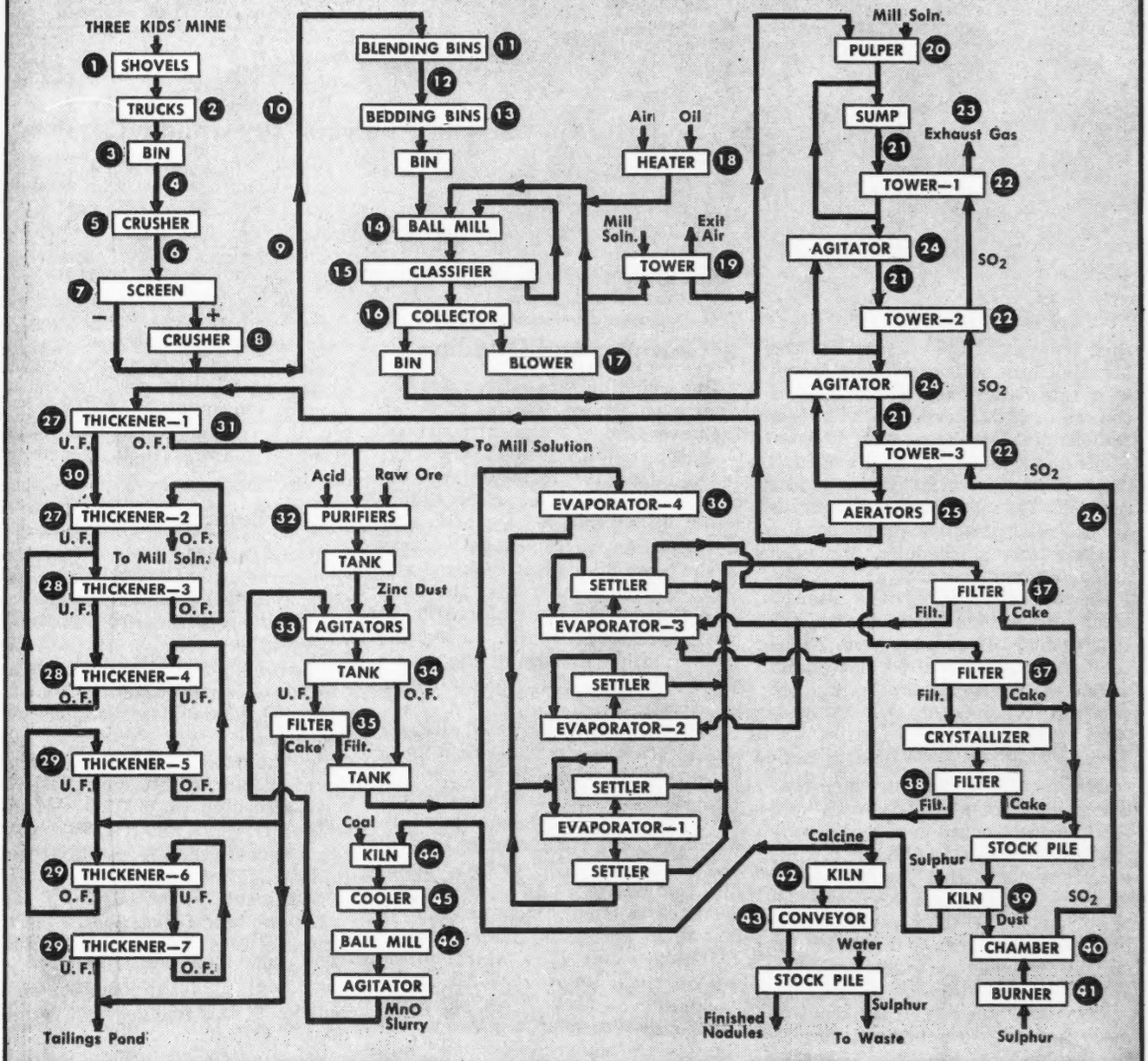
Outline of Process

Construction began in June 1942 and leaching started in August 1943, although operations in 1943 were generally limited to solving initial problems and building up solution strengths. At the end of September 1944, when the plant was shut down, production of high-grade nodules was approaching 50 percent rated plant capacity. A. A. Hoffman was appointed plant manager in 1943. John H. Cole, president of Domestic Manganese & Development Co., Butte, Mont., served as consultant on nodulizing. Beginning in June 1944, Dr. Gilbert E. Seil aided the consulting staff on problems of combustion and kiln operation.

Ore was mined from open pits by power shovel and trucked to one of three stockpiles in accordance with its grade. The stockpiled ore was

MANGANESE ORE CO.

Sulphur Dioxide Process



LEGEND

1. Power shovel, Marion.
2. Euclid trucks, 10-ton.
3. Bin, V-bottom, 15x30x18-ft.
4. Stephens-Adamson pan feeder, 54-in.x10-ft.
5. Jaw crusher, Traylor, type-H, 30x42-in., 4-in. discharge.
6. Stearns magnetic pulley, 36x31-in.
7. Symons rod-deck screen, type K, 4x8-ft., ¾-in. opening.
8. Gyratory crusher, Traylor, type TY, 4-ft., 1-in. discharge.
9. Merrick Weightometer, type E.
10. Southwestern and Vezin samplers cut sample for assay here.
11. Seven-pocket bin, each holding 300 tons, filled with S-A tripper.
12. Hardinge type C Feedometers, one under each bin.
13. Six-pocket bin, each holding 100 tons, filled by S-A automatic tripper.
14. Two 10 ft. x 36 in. Hardinge conical mills.
15. Two Hardinge No. 126 loop air classifiers.
16. Cyclone dust collectors,
17. Two Clarage fans, No. 33, 23,000 c.f.m.
18. Two air heaters, oil-fired, 7x16-ft.
19. Scrubbing tower as dust collector.
20. Vortex pulper.
21. Five Allen-Sherman-Hoff, rubber-lined, vertical centrifugal pumps, 700 g.p.m., 30 hp.
22. Eight towers, 8x8-ft., 34-ft. high, packed with 30-ft. of wooden slat baffles.
23. Exhaust gas handled by eight fans, 36-hp. motors, plastic blades, stainless steel webs.
24. Agitator, 15x10-ft., 7½ hp. motor.
25. Four Pan-American aerators in series, 12-in. rotors, 1,050 rpm.
26. Transite flues for handling SO_2.
27. Concrete thickeners, Dorr traction-type mechanisms, 250-ft. diameter, 39 sq.ft. per long ton plant feed.
28. Diameter, 200 ft., 25 sq.ft. per long ton plant feed.
29. Diameter, 160 ft., 16 sq.ft. per long ton plant feed.
30. All underflows pumped by Dorr No. 6, VMR duplex acid-proof pumps.
31. All overflows pumped by Allen-Sherman-Hoff 84 pumps. All thickener piping was rubber-lined.
32. Purifying agitators, six in series, 2,700-gal. capacity. 30-in. propeller.
33. Neutral liquor agitators, three in series.
34. Four neutral settling tanks, 35x18-ft., 24-in. side agitators.
35. Oliver precoat filter, 8x15-ft.
36. Standard, vertical, propeller-agitated, quadruple-effect Swenson evaporator, plus feed heater, four salt settlers and two-stage vacuum crystallizer. Each evaporator body is 11 ft. 3 in. in diameter; 1,716 two-inch tubes in each steam chest.
37. Oliver filter, 6x6-ft.
38. Oliver filter, 4x4-ft.
39. Allis-Chalmers roasting kiln, 11 ft. 3 in. in diameter.
40. Dust chamber, 24x26x27-ft.
41. Two 75-ton, 13x8x25-ft. concrete silos, each with Tegul melter, special Venturi burners, three combustion chambers, 8x22-ft., Mullfrax brick-lined.
42. Allis-Chalmers nodulizing kiln, three sections, with diameters of 8½-ft., 9½-ft., 8½-ft., total length, 50 ft. Central 9½-ft. zone, 16 ft. long, provided to facilitate use of boring bar. Fired by one 19-in. Pan-American oil burner.
43. Stephens-Adamson pan conveyor, 20 in. x 140 ft.
44. Reducing kiln for MnO production, 4x64-ft., Mutual Engineering Co., fired by P-A oil burner, 1,300 deg. F.
45. Baker cooler, 5x22-ft.
46. Ball mill, 3x6-ft., open circuit.

Typical Analyses of Ore Treated by Manganese Ore Co.

Constituent	Stockpile No. 1 Composite, Percent	Stockpile No. 2 Composite, Percent	Stockpile No. 3 Composite, Percent
Mn	29.5	24.1	18.2
Na	1.34	1.01	1.45
K	1.96	1.77	1.84
Ca	1.00	1.42	2.14
Mg	0.92	0.86	1.70
S	0.81	0.65	0.60
SiO_2	25.15	32.25	42.25
Al_2O_3	5.65	7.00	8.50
Fe	1.35	2.02	2.07
CO_2	0.64	1.23	1.07
Loss on ignition (1,000 deg. C)	12.65	12.23	9.51

Heating Oil Used and Moisture Content Dry Grinding System

Month	Oil, Gal. per Ton of H_2O Removed	Oil, Gal. per Long Dry Ton of Ore Ground	Feed (Average H_2O Percent)	Discharge (Average H_2O Percent)
July, 1944	30.6	2.18	14.3	8.8
August, 1944	35.2	2.01	13.4	7.6
September, 1944	28.2	2.06	12.5	6.6

Screen Analyses, Dry-Grinding System

Screen Size	Weight, Percent: Mill No. 1	Mill No. 2
Plus-65 mesh	5.6	6.2
Minus-65-plus-200 mesh	13.0	13.7
Minus-200 mesh	81.4	80.1
Total	100.0	100.0

then trucked to the crusher and the blending bins, whence it was drawn at a rate determined by analysis of the ore in each bin pocket. Ore from the blending bins then went to a set of bedding bins, which provided a plant feed of uniform manganese content. This important service was controlled by a blending chemist working one shift daily, who ran assays on bin products and set the Feedometers to yield the desired plant feed. Manganese content of the feed seldom varied more than 1 percent from the desired level and usually held within 0.5 percent when treating 25 percent ore.

Series of Reactions

Ore from the bedding bins was dry-ground, then pulped with mill solution and leached in packed towers against incoming sulphur dioxide gas, thus converting manganese dioxide into soluble manganese sulphate and some thionates. Leached pulp was washed in a thickener circuit by the ordinary process of countercurrent decantation.

Pregnant solution from the primary thickener was purified by adding sulphuric acid and raw ore, then neutralized with manganese oxide prepared in a small reducing kiln. Following filtration of iron and aluminum hydroxides, the neutral solution was evaporated to yield crystals containing manganese sulphate, manganese dithionate, and alkali dithionates, which were filtered off, then sent to a roasting kiln.

In the kiln, manganese oxide and sulphur dioxide were produced, the SO_2 going back to the leaching plant, together with make-up SO_2, and the calcine going to a nodulizing kiln to improve its physical characteristics. Because the nodules still carried excessive sulphur in undecomposed sodium sulphate, they were heap-leached with water as the final step in the process.

Crushing and Grinding

Dry grinding was chosen for the plant even though the ore mined in 1942 averaged 17.8 percent moisture. Grinding in mill solution was out because pilot-plant tests showed the solution to be too corrosive. Grinding in water, followed by thickening and filtering, was discarded because of the large filter plant required and because tests showed that the filter cake thus produced would carry 30 percent moisture at best, an impractical situation in view of the subsequent countercurrent decantation to be used.

Pilot-plant tests indicated that air classification was possible with up to 8 percent moisture in the ground ore; therefore, a Hardinge Thermal dry-grinding system was selected, in which water is evaporated in the ball mill. Rated at 16,000 cu.ft. per minute, the system at 160 deg. F. was designed to remove moisture equivalent to 10 percent of the content of 1,000 tons of ore daily, which, on the ore already mined, would leave ground ore of about 8 percent moisture. Moisture-laden air was vented through a scrubbing tower using mill solution, a Cottrell precipitator having proved unsuitable in this instance.

Moisture Cuts Capacity

Though the dry-grinding system is the logical choice for similar problems, some difficulties must be mentioned. Mill capacity falls off with increase in moisture, even with excess of vented air to remove it. Maximum capacity on ore of 12.4 percent moisture was about 450 tons per mill, and the ground ore then still contained 6.7 percent moisture.

The air-classification system needs further development, because it tends to produce an excessive amount of fines and the circulating load is low. At Three Kids these factors were unimportant because the ore was soft. Ball consumption amounted to only 0.4 lb. per ton of ore ground. Consumption of oil for drying and average screen analysis of ground ore are given in accompanying tables.

Leaching Plant

In the leaching towers, most important of all the plant's units, sulphur dioxide gas enters at the bottom and meets the cascading pulp. Dissolved SO_2 reacts with the MnO_2 of the ore according to the reaction: $H_2SO_3 + MnO_2 = MnSO_4 + H_2O$. Some important side reactions also take place.

Polythionates, of which dithionate is most important quantitatively, form according to: $2H_2SO_3 + MnO_2 = MnS_2O_6 + 2H_2O$. High temperatures and, especially, low pH retard thionate formation, and at pH 1.0 little thionate forms.

Thiosulphate forms due to the reaction between elemental sulphur and sulphurous acid: $S_{(el)} + H_2SO_3 = S_2O_3^- + 2H^+$. It decomposes upon addition of acid and does not form if the pH is kept low.

Manganese sulphite is quite insoluble and was found in the leach tailing when the pH rose above 3.5. The pH therefore had to be kept low to prevent the undesirable reaction: $Mn^{++} + H_2SO_3 = MnSO_3 + 2H^+$.

Inhibition of the foregoing side reactions thus depends on a low pH in the leach towers, which in turn depends on formation of sulphuric acid in the process. The basic reaction is: $H_2SO_3 + \frac{1}{2}O_2 = H_2SO_4$, which is catalyzed by such elements as iron and manganese. The amount of H_2SO_4 thus formed depends on several factors. For example, diffusion of finely divided gas bubbles into the body of the pulp, such as can be obtained by mechanical means, gave the maximum yield of acid. The mechanism of gas absorption in

towers is not favorable to acid formation. High pH of pulp inhibits it. The Pan-American aerators shown in the flowsheet were intended to form H_2SO_4 by oxidizing residual SO_2.

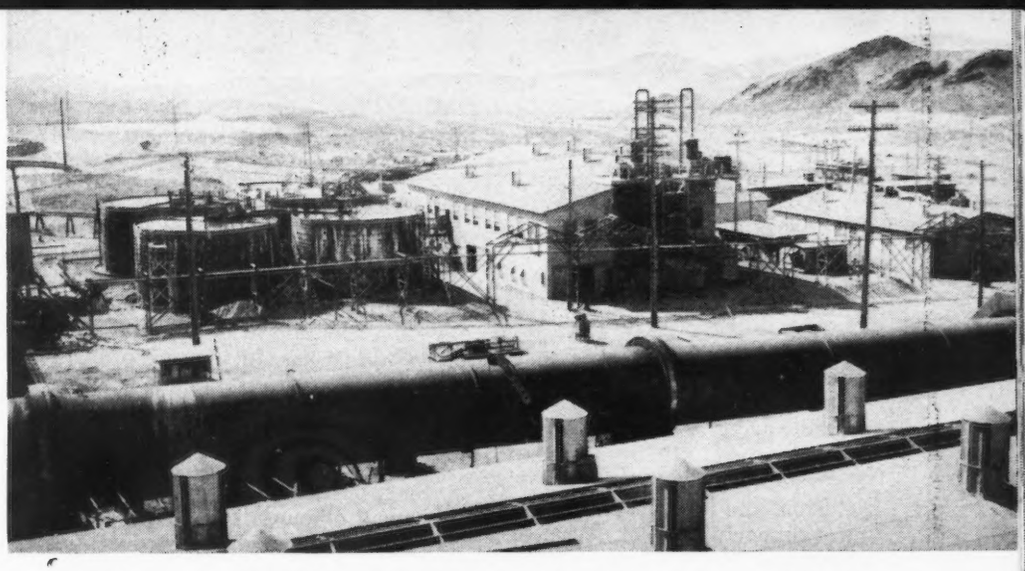
Control of $CaSO_4$

Alkali and alkali earth metals also dissolve and form sulphates during leaching, but SO_2 was found chiefly responsible for this, rather than the free sulphuric acid present. Calcium sulphate was particularly objectionable because of its scale-forming habit, and although the factors in its formation are still difficult to define, the following conditions combined gave lowest $CaSO_4$ content: low pH, high manganese concentration, low free SO_2 content of leach tailing.

Several leaching techniques were studied in the pilot plant, principal emphasis being given leaching in mechanical agitators and leaching in packed towers. Because of its apparent simplicity, the latter was adopted for the Las Vegas plant, but it must be pointed out that Three Kids ore was the only one of the ores tested that responded to tower leaching, and that even on Three Kids ore leaching in agitators gave better results. The soft porous wad of the Three Kids ore reacts readily with SO_2 and manganese dissolution is rapid.

Dimensions of the towers are given with the flowsheet. Draft through the towers was controlled at first by eight stainless-steel fans, driven by 30-hp. motors, and drawing gas from the top of No. 1 tower. These fans controlled also the draft through the roasting kiln, the dust chamber, and the Transite flues for the entering SO_2. The steel fan blades failed in about two weeks of operation, however, and fans were substituted made of a heavy stainless-steel web, to which were bolted, with lead bolts, blades of laminated plastic board.

The towers were packed with frames of inclined-slat baffles made of wood. $CaSO_4$ scale was noted on the baffles in the pilot plant work but caused no difficulty at that time.



IMPURITIES were removed from solution containing $MnSO_4$ in this part of plant. Neutralization brought down iron and alumina; zinc dust brought down copper. Purification of solutions proved key to most of plant's problems. Roasting kiln is in foreground.

Trouble With Leaching

It seems pertinent to discuss here some basic difficulties that affected profoundly the chemistry of plant solutions and the performance of several plant units. At the start of operations, the thickener bottoms leaked, and to remedy this, the rakes were raised 9 in. and the intervening space was filled with low-grade material, which, however, contained enough gypsum to build up a saturated calcium sulphate solution in the entire thickener system.

When this solution was passed back through the leaching plant to build up its manganese content, calcium sulphate precipitated on the tower baffles because of the temperature change. At first, gas scrubbing was excellent, but the baffles, spaced at 2 15/32 in., soon became plugged with $CaSO_4$. It was decided to widen the baffle spacing, which increased the life of the baffles but made gas scrubbing more difficult. To offset excessive loss of SO_2, which often made working conditions almost unbearable, manganese extraction had to be sacrificed, and eventually two 50-ft. stacks were built to keep the exhaust gas out of the plant.

Incomplete extraction of manganese resulted in a rise in pH of leach solutions, with attendant increase in sulphite, thiosulphate, and dithionate formation. This in turn caused difficulties in other parts of the plant, which will be described later. Also, it was discovered that the aerators were ineffective in forming H_2SO_4 at high pH. It was definitely proved (see table) that acid formation of the system was a function of manganese extraction.

Generally speaking, the leaching towers were found to be deficient from the standpoint of acid formation, and the situation was aggravated by the fact that the ore possessed a widely fluctuating power to neutralize acid.

That good manganese extraction can be obtained by leaching Three Kids ore in towers has been fully demonstrated. Average manganese extraction was 84 percent. Efficiency of gas absorption depends to a great extent on the flooding rate. In the original design, a flow was provided for of 2,100 g.p.m. to each parallel row of towers. However, the wider-spaced baffles required a higher flooding rate, so that instead of 5 g.p.m. per square foot of tower cross-sectional area, as planned, the flow was about 7.5 g.p.m. Plugging of baffles with $CaSO_4$ is a function of pH of leaching solution, and at a pH

How Manganese Extraction Varies With pH of Leached Pulp

Period	Average Mn Extraction Percent	Usual pH Value of Leach Tails
Feb. 1-7, 1944	80	3.5
Aug. 1-21, 1944	80	3.0 to 4.4
March 15-21, 1944	85	3.0
Dec. 10-20, 1943	93	2.5 to 3.0
Dec. 20-31, 1943	95	2.0 to 2.8

Manganese Content and pH of Thickener Overflows

Thickener	Mn Concentration, G.P.L.			pH		
	July 31	Aug. 31	Sept. 30	July 31	Aug. 31	Sept. 30
No. 1	130.0	137.0	136.0	2.7	3.3	3.9
No. 2	65.2	75.8	79.4	5.9	6.4	6.2
No. 3	33.2	43.3	65.0	6.8	6.8	6.7
No. 4	18.9	23.9	30.3	6.1	6.9	7.3
No. 5	6.0	13.2	16.3	6.6	7.1	7.4
No. 6	2.3	2.4	2.9	7.1	7.1	7.4
No. 7—Not in use						

below 2.0 scale formation was minimized.

Separation of strong manganese sulphate liquor from the leach residue was one of the most difficult problems because the fine slimes formed during leaching do not readily flocculate, settle, or filter. Exhaustive filter tests were not encouraging. Various flocculating reagents were tried, with indifferent results. In thickener tests, conditions promoting good settling were: high temperature, low specific gravity of solution, and low pH, the latter being most important. Yet, because high concentration of manganese (high specific gravity) had to be maintained in solution going to the evaporator, large thickener areas had to be adopted. (See flowsheet.)

The main difficulty in the thickener installation was with the expansion joints in the concrete walls and bottoms. At least one thickener was out of service at any given time for this reason. Little trouble was met with the mechanism and the pumps. In 1944 washing efficiency was 97.4 percent with six thickeners and 98.6 percent with seven.

Purification

Pregnant manganese solution contained several impurities that had to be removed prior to evaporation, and in addition it had to be neutralized to prevent corrosion of evaporator equipment. Trouble was caused early in plant operations, however, by release of SO_2 in the evaporator when the pH of the pregnant solution was around 3. Excess of SO_2 was eventually removed by adding H_2SO_4, which converted bisulphite ions to sulphurous acid, and then adding small amounts of ground raw ore to oxidize the acid. This procedure was worked out only in September 1944, but after it was used, SO_2 content of evaporator solutions dropped from about 2 to 0.1 g.p.l., and no further trouble was encountered.

To neutralize the free H_2SO_4 present, manganous oxide was used, inasmuch as raw ore (MnO_2) would not serve the purpose. Sufficient manganous oxide slurry was added to the pregnant solution to raise the pH to about 5.5. Iron and aluminum hydroxides thereupon precipitated, and copper was also brought down from 100 to less than 10 mg.p.l. by adding zinc dust in about twice the theoretically required amount. Sodium sulphide was tried but abandoned in favor of zinc dust. In 1944, an average of 0.044 lb. of MnO per gallon of solution was required. Use of precoat filters was found to be the only satisfactory solution to the problem of filtering the settled sludge.

Manganese oxide, of required purity, was prepared by reducing calcined $MnSO_4$. Minus-¼-in. calcine from the roasting kiln, together with 7 to 13 percent by weight of fine coal, was fed to a 4x64-ft. rotary kiln tightly sealed at both ends. Fired at the upper end with a single oil burner, temperature in the kiln was about 1,300 deg. F. and a strong reducing atmosphere was maintained therein. Reduced oxide was wet-ground as needed and was pumped to the neutralizing plant. Degree of reduction, as measured by solubility in excess of H_2SO_4, was more than 98 percent.

Evaporation

On the basis of pilot-plant work, the evaporator was designed to make two products: $MnSO_4 \cdot H_2O$ crystals to go to the roasting kiln, and alkali dithionate crystals to be stockpiled for eventual recovery of sulphur. The former, possessing an inverse solubility curve, is less soluble at higher temperatures. The latter, and manganese dithionate as well, possess a normal solubility curve and were therefore to be recovered in a vacuum crystallizer.

To obtain a sharp separation between the two, enough of the alkali metals must be present to balance the dithionate radical in solution; otherwise manganese dithionate will form.

Because of difficulty in control of leaching, unexpectedly large quantities of dithionate were formed, and not only was there insufficient alkali present to take up the dithionate, but the crystallizer was overloaded. Danger of SO_2 forming in the evaporator as this dithionate decomposed on heating was always present. Then, too, because of its high manganese content, the dithionate product could not be held back, but had to be treated along with the $MnSO_4$ crystals, which later caused trouble in the roasting kiln.

Further difficulty was caused at first by high concentrations of sulphite in the leach solutions which yielded SO_2 on heating. This was corrected eventually by adding H_2SO_4 and raw ore, as noted previously, but until then, SO_2 corrosion in the evaporator had to be fought by placing

Analyses of Evaporator Products on Last Day of Operation

	Evaporator Feed, 9/30/44, G.p.l.	$MnSO_4$ Cake, Percent, 9/30/44	Dithionate Cake, Percent, 9/30/44
Mn	130.0	21.6	5.9
Total S	111.0	16.8	22.1
S_2O_6	117.0	17.2	56.2
Na	3.8	2.25	6.3
K	2.2	0.22	1.2
Mg	3.4	0.37	4.5
Cu	0.010	...	...
Fe	tr.	...	...
Al	tr.	...	...
Ca	0.40	...	0.17
Cl	1.78	0.46	0.17
pH	5.5	...	...
Drying loss	....	21.4	25.6

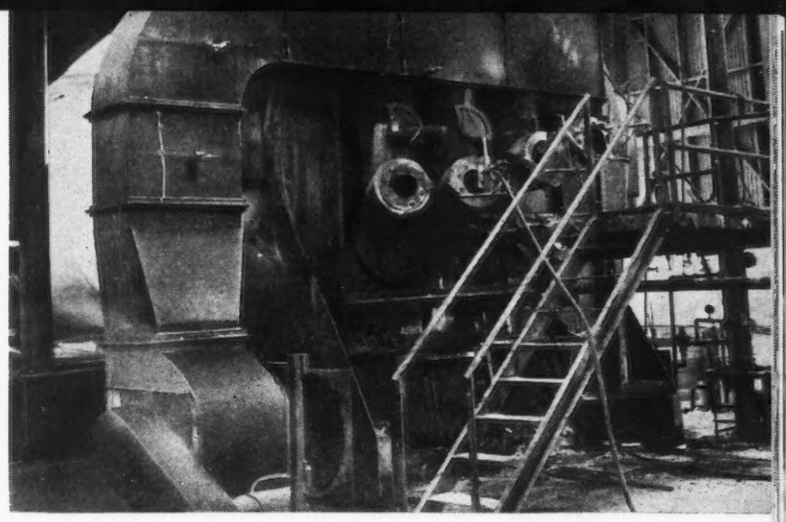
EVAPORATION of purified solutions was to produce $MnSO_4$ crystals in this quadruple-effect evaporator circuit. Because of operating difficulties, mixture of sulphate and dithionate crystals was actually formed, and proper control was attained only near end of operations. Note water spray on pile of nodules in background that washed out residual Na_2SO_4.

Changing Composition of Salts Traversing Roasting Kiln

Distance From Feed End, Feet	H_2O Percent	Mn, Percent	S, Percent
Feed	19.3	29.0	17.9
96	14.0	30.4	18.2
146	5.3	29.5	18.1
196	...	28.9	17.7
246	...	31.2	18.3
296	...	37.2	17.8
Discharge	...	63.1	2.06

Accountable Sulphur Losses for Period Sept. 15 to 30, 1944

	Tons
Exit gas, sublimed sulphur, etc.	0.26
Undecomposed alkali sulphate in nodules	0.05
Unroasted $MnSO_4$ in calcine	0.01
Total losses	0.32



ROASTING KILN was fired at discharge end by multiple Seil burners, two burning sulphur and three oil. Crystals became molten on heating; therefore molten zone was kept close to discharge end to facilitate removal of rings formed when molten crystals solidified on roasting. Varying feed composition and rate caused most trouble.

caustic sprays in the vapor lines. In addition, MnO slurry was injected into the evaporator to counteract acid formation, and later caustic soda was used. The only real solution, however, was better control of the leaching and purification steps, but before this had been attained, sufficient damage had been done to require re-tubing the evaporators.

Calcium sulphate-carbonate scale formed in the evaporator tubes to an extent that required periodic acid boil-outs. Copper was troublesome at first, but use of zinc dust instead of sodium sulphide solved that problem. It is unfortunate that solutions purified of copper and sulphites became available for evaporation only in the last month of operation. In any case, before the plant was shut down, the principal operating problems of evaporation had been solved.

Roasting

Pilot-plant work indicated that manganese sulphate could be roasted in a rotary kiln with very high recovery of sulphur for re-use in leaching. The net reaction can be expressed as follows:

$$3\ MnSO_4 + \text{heat} = Mn_3O_4 + 3SO_2 + O_2.$$

It is believed that the initial step of decomposition may form equimolal parts of SO_3 and SO_2, although at roasting temperatures (2,000 to 2,200 deg. F.) the equilibrium, $SO_3 = SO_2 + \frac{1}{2}O_2$, lies so far to the right that very little SO_3 ever forms. Dithionate salts begin to decompose at lower temperatures than the sulphate, according to the reaction:

$$Na_2S_2O_6 + \text{heat} = Na_2SO_4 + SO_2$$

Some rings formed in the pilot-plant kiln, but they were so soft and easily removed that it was expected such rings would fall by their own weight in a large kiln. Fresh salts gave least trouble with rings, but salts stored several weeks were difficult to handle. Tendency to form mud rings was controlled by hanging chains inside the kiln, and prevention of overheating of kiln walls aided in curbing the salt rings.

In the plant kiln, the first 36-ft. section contained a spiral and heavy chains, but chains were later added through the drying zone and eventually extended to 145 ft. The chains were unaffected by SO_2.

In general, the roasting kiln was the seat of more lost-time difficulties than any other phase of operations. The most serious trouble lay in the unexpected behavior of material being roasted.

Large amounts of alkali salts went to the roaster because of the poor separation (already mentioned) between manganese and alkali salts in the evaporator, caused in turn by high dithionate content of the leach solutions. The alkali salts formed in the kiln a low melting point eutectic with $MnSO_4$ that fused at between 1,300 and 1,500 deg. F., then later solidified as the temperature rose and sulphur was driven off. Rings formed as a result, and the effect was intensified by the fact that the salts roasted had been stockpiled for some time because of the uneven rate of salt production.

If allowed to remain in the kiln for a matter of hours, these salt rings hardened to a point where they could be removed only manually after shutting down the kiln. Not until June 1944 was a successful solution for the problem found in the form of a power-operated boring bar, shown in an accompanying photograph, which was equipped with a chisel bit and water jets. When rings formed thereafter, the heat was turned off, the bar was driven in, the bit dug into the base of the rings, and steam from the water jets exploded rings and wall cake.

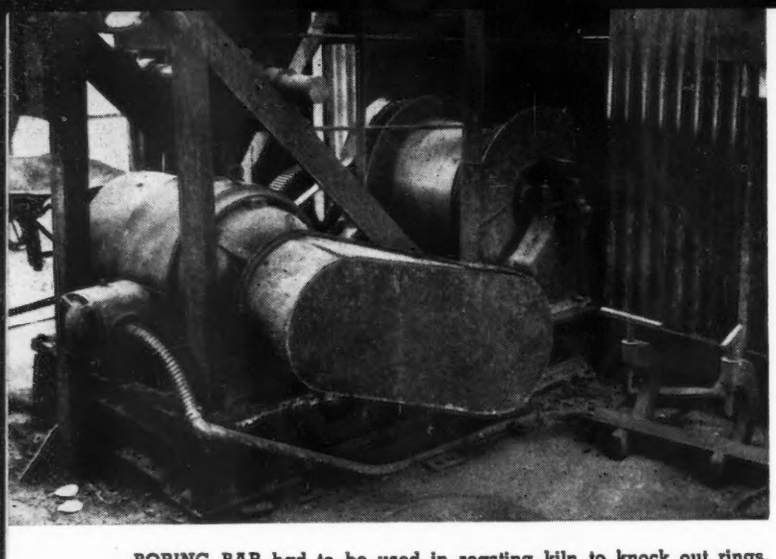
Original ideas on firing also had to be revised, for it was found best to have the zone of molten salts close to the discharge end in order to facilitate removal of rings. Several short, sharp flames directed against the material gave best results, and a Seil burner system, including two sulphur and three oil burners, established this condition. Either oil or sulphur burners could be used at will.

Original equipment for dust collection included Multiclones, but these proved inadequate under existing conditions. A dust chamber measuring 24x26x27 ft. was thereafter used, but this still did not give complete clearance of dust, and flues carrying SO_2 to the leaching plant had to be cleaned periodically.

Nodulizing

Calcine from the roasting kiln had to be nodulized to increase its physical strength and to reduce the quantity of fines. A secondary purpose was better conversion of manganese sulphate to oxide, inasmuch as some sulphate came through the roasting kiln undecomposed, owing to the short burning section already referred to.

Temperature required for nodulizing varied with the purity of the calcine. When considerable alkali was present (which acted as a flux), temperature varied between 2,400 and 2,600 deg. F. Ring formation was handled by boring the kiln once each shift with a 20-in., water-cooled bar, 38 ft. long, made by Allis-Chalmers,



BORING BAR had to be used in roasting kiln to knock out rings. Made of 3-in. pipe, reinforced for 40 ft. near the tip, and 158 ft. long, the bar rested in a channel iron guide, and was handled by ⅝-in. cable on a 30-hp. winch. Note extra chisel bit on frame. Water, shot through jets, formed steam, which exploded rings.

Typical Analyses of Unleached Nodules.

Note Rise in Sulphur With Increased Alkali Content

Sample	Assay, Percent Mn	Ca	Mg	Fe	S	Na	K
Oct. 1943	68.1	0.20	0.10	0.56	tr.	0.75	...
Dec. 1943	63.6	0.40	0.32	0.15	0.49	0.13	...
Early 1944	58.8	0.89	0.95	0.68	2.18	2.04	1.43
Late 1944	61.1	0.54	0.74	0.56	1.6	1.96	1.1

Leached Nodules Typical Analysis

	Percent
Mn	64.78
S	0.25
Fe	0.56
P	0.010
SiO_2	2.82

and equipped with a Stellite bit. It was set on a rack-and-pinion, motor-driven carriage.

An important lesson in the behavior of alkali salts was learned in that they partly volatilized and condensed in the waste-heat boiler tubes and in the Cottrell precipitator. Because dust loss in the nodulizing kiln was only a fraction of 1 percent of the feed, a stack was planned to bypass the boiler and the Cottrell.

Purity of the nodulized product varied with the grade of the roasting kiln feed. When dithionates were treated along with manganese sulphate, the result was an increase in the alkali sulphate content of the feed, which did not entirely decompose in the kilns. To eliminate the sulphur thus carried into the nodules, the storage piles were sprayed with water from a hose. Four days of spraying was required to bring the sulphur content of a 500-ton pile down to less than 0.5 percent. Longer treatment could have reduced the sulphur content to less than 0.1 percent, but this was unnecessary. Water leaching caused no injury to the physical characteristics of the nodules.

Sulphur Losses

Sulphur was lost from the plant chiefly in the exit gas from the towers, and also in solution spillage, as alkali sulphate in the nodules, and in incomplete roasting of $MnSO_4$. A record of accountable losses is given in an accompanying table.

Make-up sulphur was supplied by burning elemental sulphur. The steam pipes originally placed at the bottom of each melting silo (see flowsheet) soon became coated with carbonaceous matter and were replaced by a Tegul melter with a capacity of 75 tons of sulphur per day. The duplex piston pumps originally used to deliver molten sulphur to the burners were replaced by ¾-in. Worthite pumps, built to operate in a vertical position.

The burners designed by Texas Gulf Sulphur Co. gave excellent atomization when clean, but under wartime conditions sulphur was delivered to the plant in open cars and the cinders and dirt thus introduced caused frequent burner trouble. The problem was finally solved by the development of non-clog burners operating on the Venturi principle.

Originally, SO_2 from the burners was directed to the firing end of the kiln, which was done to conserve heat and cool the gas before leaching. However, this meant that if the kiln were shut down, leaching had to stop, and two sulphur burners were therefore moved to discharge into the dust chamber.

Summation

Operation of the Las Vegas plant demonstrated that high-grade manganese nodules can be produced on a large scale, but at a non-competitive price, from low-grade domestic ores by the SO_2 process. Much has been learned regarding both chemistry and equipment of the process. Rate of progress during plant operations was disappointingly slow, due to many factors, chief among which might be mentioned the following:

1. From sheer necessity, the jump had to be made from a pilot plant treating 3 tons daily to a plant of 1,000 tons' daily capacity.

2. Despite efforts to obtain and use standard equipment, it was not always available, and even some of the best manufacturers had to supply inferior products.

3. There existed a lack of competent plant designers, which too frequently resulted in unworkable designs.

4. Because of labor shortages, operation of the plant had often to be entrusted to inexperienced men.

5. Difficulty in obtaining parts and supplies often delayed necessary plant alterations or repairs.

The hope of attaining 50 percent capacity in nodule production was blasted during the last month of operation by an explosion in the kiln, although production rate approached 50 percent following the accident. The management believed that 75 percent of capacity would have been reached by the end of 1944.

The SO_2 process was found in testwork to be applicable to a great variety of domestic ores, including those from the Three Kids deposit; Artillery Peak, Arizona; the Cuyuna Range, Minnesota; Presque Isle, Maine; and central California. It should be possible, on the basis of existing experience, to produce nodules by the SO_2 method at a processing cost of $0.50 to $0.60 per ton, exclusive of cost of ore. This presupposes a plant producing about 200 long tons daily of metallic manganese in the form of nodules.

In conclusion, I wish to express my appreciation to Charles G. Maier, original inventor of the sulphur dioxide process, who was very generous with his advice during early stages of the investigation; to Messrs. M. C. Lake, A. A. Hoffman, and John D. Sullivan, who contributed by discussion during preparation of this manuscript; and to the Manganese Ore Co. for permission to publish this material.

A Safe, Effective Roaster For Sulphide Ore Tests

OBA WISER, Consulting Metallurgist, Britannia Mining & Smelting Co., Ltd., Britannia Beach, B. C., Canada

IN OUR RESEARCH WORK we recently had the problem of roasting arsenopyrite. A search of catalogs failed to disclose suitable equipment. As a consequence, we had the choice of roasting the ore in a muffle or an electric furnace, both requiring hand rabbling, with attendant dust and fume losses, or of evolving an entirely new piece of equipment.

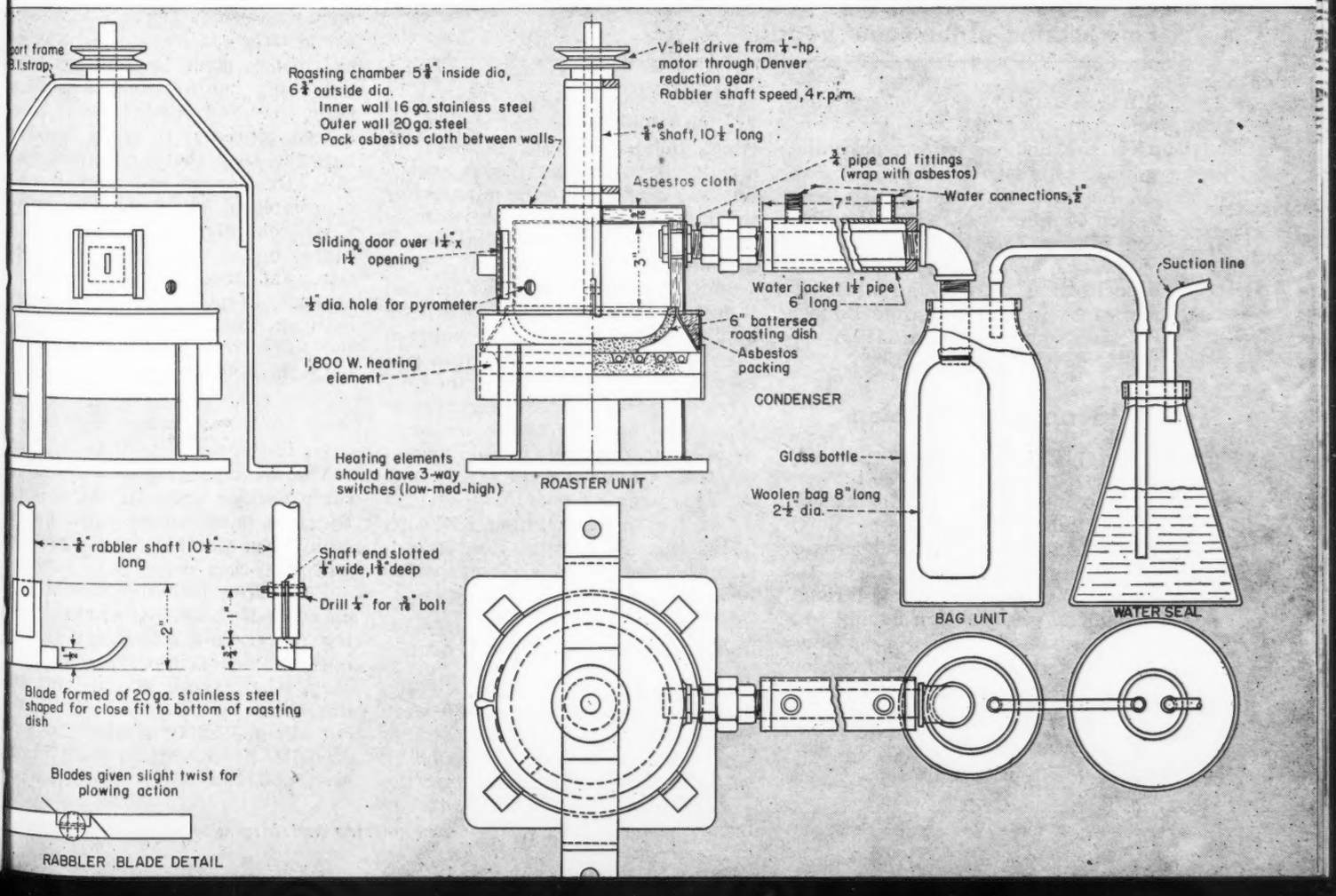
The apparatus shown in the accompanying line drawing resulted from an attempt to follow the latter course. Capacity of this roaster, which is not patented, is from 40 to 200 grams, but it can be stepped up to 500 or 600 grams if an 8-in. fireclay dish and a larger roasting chamber are used. The heating elements are the ordinary commercial type, and should have three-way switches, high, intermediate, and low, for temperature control. By adjusting the vacuum to admit, or to pull through, just enough air to effect oxidation, roasting temperature can be controlled within a few degrees.

In roasting our samples of arsenopyrite, the arsenic is recovered as a snow-white powder assaying from 90 to 99 percent As_2O_3, with recovery very high. Proper concentration of SO_2 can be maintained while the arsenic is being driven off (end point shown by disappearance of blue-white flame), after which the remaining sulphur can be burned off.

No special precautions are necessary, other than that of adjusting the vacuum to prevent escape of poisonous white arsenic fume from the roasting chamber. The only product treated so far in the roaster has been arsenopyrite, and for this purpose the apparatus has been ideal. However, as designed, it should be suitable for the controlled roasting of any sulphide material.

The upper temperature limit within the roasting chamber is about 1,300 deg. F. with the apparatus shown. A high sulphur content in the material to be roasted would increase the temperature slightly. The sketch does not show a dust chamber, but if dust passes over, it can be caught by inserting an extra chamber between the roasting unit and the condenser ahead of the bag unit. The dust-chamber temperature should be held high enough to prevent either elemental sulphur or arsenic precipitating out. A small electric heater, say 1,200 watts, under the dust chamber will serve.

Auxiliary units for the roaster include a single condenser made from 1½-in., ¾-in., and ½-in. pipe, a bag unit, and a water seal as shown.


port frame
S.I. strap
Roasting chamber 5⅜" inside dia, 6¾" outside dia.
Inner wall 16 ga. stainless steel
Outer wall 20 ga. steel
Pack asbestos cloth between walls
V-belt drive from ¼-hp. motor through Denver reduction gear.
Rabbler shaft speed, 4 r.p.m.
⅜" shaft, 10½" long
Asbestos cloth
¾" pipe and fittings (wrap with asbestos)
7"
Water connections, ½"
Sliding door over 1½" x 1½" opening
3"
Water jacket 1½" pipe 6" long
Suction line
½" dia. hole for pyrometer
6" battersea roasting dish
Asbestos packing
1,800 W. heating element
CONDENSER
Heating elements should have 3-way switches (low-med-high)
ROASTER UNIT
Glass bottle
Woolen bag 8" long 2½ dia.
⅜" rabbler shaft 10½" long
Shaft end slotted ⅜" wide, 1⅛" deep
Drill ¼" for ⅜" bolt
2"
BAG UNIT
WATER SEAL
Blade formed of 20 ga. stainless steel shaped for close fit to bottom of roasting dish
Blades given slight twist for plowing action
RABBLER BLADE DETAIL

Building Boliden's Sixty-Mile Aerial Tramway

Despite the rigors of two winters in Swedish Lapland, construction proceeded continuously for 16 months from the time staking of the route began

WHAT IS SAID to be the longest wire-rope tramway in the world today connects the Boliden copper-gold mine, in the Vasterbotten district in Swedish Lapland, with the Kristineberg region 60 miles west, where the Boliden Mining Co.[1] has other mining operations, based on pyrites and zinc deposits that were found when explorations was pushed from Boliden up the Skellefte Valley. Their exploitation was begun in 1939.

Transport a Problem

The problem of transport, which had been relatively small at the outset, became greater as operations were extended. Although the North Swedish mainline railroad crosses the Skellefte River in this area, the ore occurrences are scattered through a roadless, waste region having endless morasses and steep mountains. Autumnal rains, lengthy thaws, low winter temperatures, and heavy snowfalls characterize the climate.

[1]The mining, milling, and smelting operations of the Boliden Mining Co. were described in E. & M. J. in the issues of June and July, 1932.

Light 3½-ton trucks hauling a 1½-ton trailer were used at first between Boliden and the railroad, an airline distance of 6 miles. A branch line was next built to the mine. After the Boliden company began to mine regularly at Kristineberg in 1939, a highway, 65 miles long, was built from the latter place to Boliden and a fleet of 30 10-ton trucks was soon hauling ore on two shifts between the two points. Only 7 or 8 tons was carried per truck because of the hilly terrain. Transport costs were so heavy that only the better ore could be taken to the smelter. Cold weather played havoc with the trucks and, the road having a poor foundation, a set of ten tires, weighing 1,100 lb., lasted only six months. Rubber consumption per ton of ore transported was 45 oz.

Tramway Decided Upon

With the war, transport costs, fixed at 3c. per ton-mile in 1939, were soon doubled. The situation came to a head when it became impossible to get tires, at the same time that the Government requested an increase in copper output. Choice lay between a ropeway and a railroad and the former was decided upon. A ropeway would offer considerable advantages provided it could be built under the prevailing unfavorable conditions. Only steel and cement would be required. Moreover it would need only half the steel that a railroad would take. By forcing the work it could be completed in 18 months or less. First cost of a ropeway would be higher owing to the war, but operation and maintenance would be cheaper. Negotiations then ensued between the Boliden company and the Nordström Ropeway Co., which built the line.

The Route

The accompanying map shows the route decided upon. It takes in the Bjurfors mine, where work had already been started, and a number of still unworked deposits.

From Kristineberg the line runs up a gradient over Hornberget, rising 750 ft. in a mile. Then traversing wet moors it arrives at Ytterberg, where there is a driving station. This is the only point that is not also a loading station for some deposits. From here it runs to Strömfors, which has a driving station and

t Lake Mensträsk the tramway crosses the ater on a dozen columns to Mensträsk sta-on, on a point that juts out into the lake. re is known to lie beneath the lake bottom.

acilities for loading ore from the ickel mine at Lainijaur and the tate copper mine at Adak, both of hich send their ore by motor truck Strömfors, 25 and 35 miles re-pectively.

At Rackejaur, the next point, is a ine owned jointly by Boliden and e State, which contains large sul-ur pyrites deposits. The line then osses Lake Mensträsk on a dozen lumns to the Mensträsk station, on point jutting out in the lake. Ore known to lie beneath the lake bot-m here.

The route then runs to Bjurfors, here the company leases a State-wned copper mine, which has been orked during the war at a forced ace. Thence it crosses a stream and to Asen and Kusfors. At the latter oint, the ore can be discharged om the ropeway for delivery to the ain railway line. The ropeway then osses the Skellefte River with a 70-yd. span between masts 125 ft. gh.

The next station is Renström, be-ond which the ropeway crosses the eep and high Storbergel, then de-cending to an extensive sodden moor a difficult passage—and thence to oliden.

Construction Details

Details of the Boliden ropeway as ilt and operated are tabulated sep-rately.

The ore or other material is car-ed in plate containers or buckets aving a lid to prevent dried concen-ate from being wetted by snow or oisture. The suspension gear of the arriers in all cases is fitted with ur wheels.

Carrying cables are of the locked-oil type. In the driving station the auling rope runs round a two-rooved sheave with wood-lined fric-on surfaces. Eight 135-hp. variable-peed motors furnish the power. riving machinery, sheaves, rollers, d carrier wheels run on roller earings.

Cables and ropes are mounted on 4 concrete columns 8 to 125 ft. gh. Up to a point 70 ft. high, the asts are massive cylindrical col-mns resting on square pedestals. rom 70 to 125 ft. they are hollow d are massive at the top. The two 25-ft. masts at the Skellefte River e 7 ft. in diameter and have stairs d electric light in the interior.

Details of Boliden Aerial Tramway

Length	60 miles
Number of carriers	915
Capacity, per year, with 915 buckets	300,000 tons
Capacity, per year, with more buckets	500,000 tons
Capacity/hour, main line to Boliden	50 tons
Net load/carrier	1¼ tons
Capacity/hour, return line, Boliden-Rackejaur	3 tons
Net load/carrier, return line, Boliden-Rackejaur	¼ ton
Capacity/hour, return line, Rackejaur-Kristineberg	23 tons
Distance between carriers	255 yd.
Speed of carriers, 9 ft./sec.	Approx. 6 m.p.h.
Time between carriers	86 sec.
Number of concrete columns, 8 to 125 ft. high	514
Longest distance between columns, yd.	470
Shortest distance between columns, yd.	12

Part of the ropeway superstructure consists of 25 cable-tightening stations of open-frame steel construction. The ten driving and loading-and-unloading stations are built of steel with roofs of Eternite slate. Roof and walls are supported by the steel framework of the stations, which in turn rests upon a concrete foundation. The tension weights of the carrying cables weigh 30 tons. In each driving station there is a room for the electric equipment and a telephone room.

The loading station at Kristineberg has been cut out in the rock underneath the large concentrate storage bin, the carriers being loaded through chutes in the floor. At Boliden the terminus is a higher structure, with concrete bins into which the carriers empty. Railroad cars are loaded from chutes having compressed-air operated gates.

Automatic Operation

Operation is wholly automatic and according to the Nordström patent. Loading, discharging, and handling of carriers are done without manual tending. Only linemen for oiling and inspection are required.

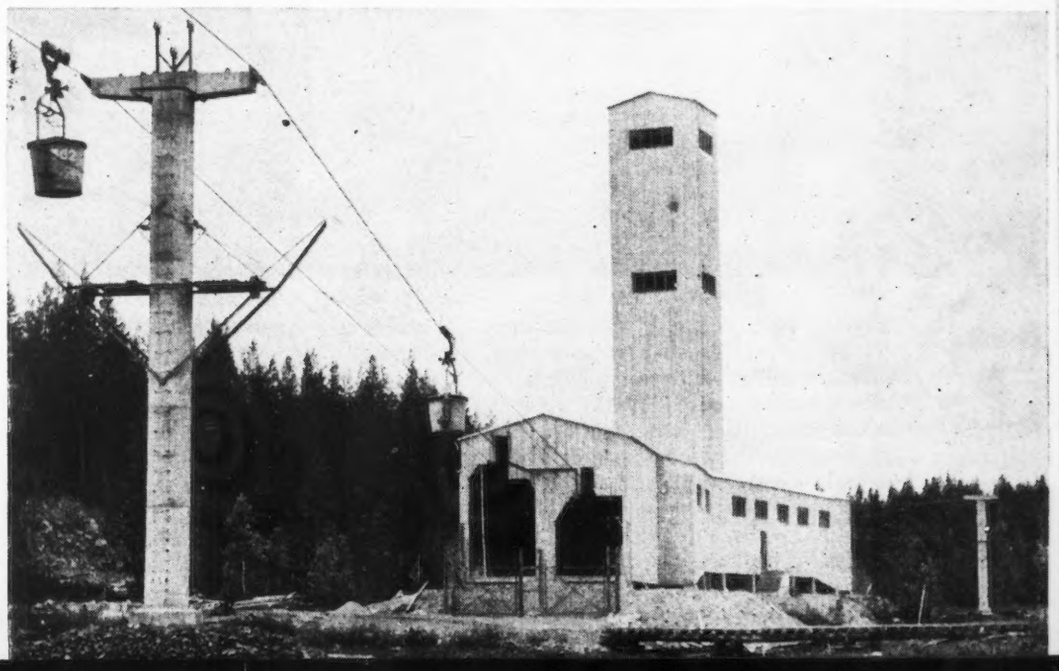
The section from Kristineberg to Rackejaur was planned for a load on both cables so that ore could be sent to the former place for concentration before being sent to Boliden and Rönnskär for smelting.

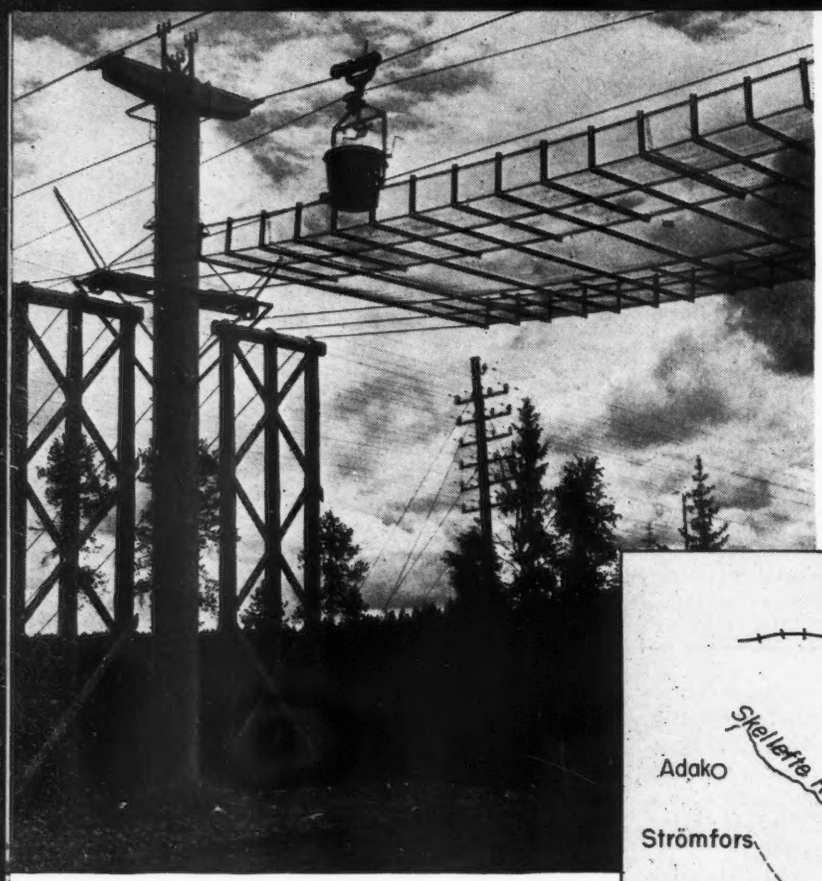
Staking the Route

Staking of the route was begun early in January 1942, with 170 men. The ground had to be cleared of snow, trees cut down, and top soil cleared away. At times the temperature was as low as minus 50 deg. F.

The period of daylight was short,

AT THE DRIVING STATION at Strömfors, here seen, facilities have been provided for loading ore from mines at Lainijaur and Adak, 25 and 35 miles away.

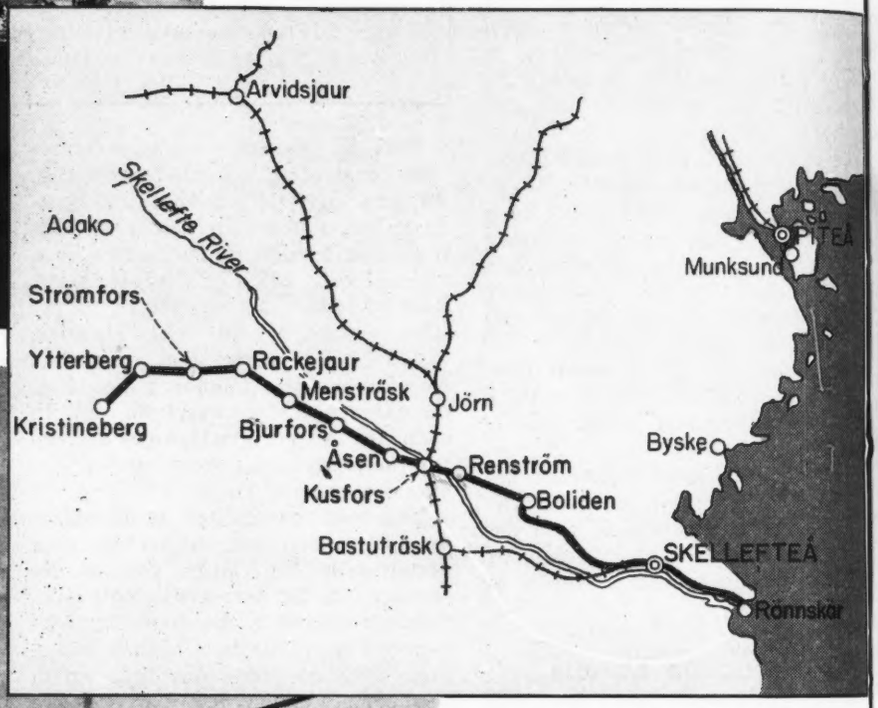




NETTING PROTECTS the highway where the tramway crosses it o one of the concrete "towers" (left).

AT BOLIDEN the tramway terminus is equipped with concrete bin into which the carriers empty. Railroad cars are loaded from chute having gates operated by compressed air (below left).

THE 60-MILE ROUTE of the aerial tramway runs from Kristineberg t the company's plant at Boliden. Only the section from Kristineber to Rackejaur is planned for a load on both cables (below).



amounting to 5 hours on clear days. Visibility was frequently poor or almost nothing, due to snowfalls or cloud vapors caused by the cold. To avoid difficulties met ordinarily in staking (with a compass or rocket signals) searchlights of army model were placed at the end points of each stretch and made to throw vertical shafts of light overhead, which served as targets. This was helpful although ice crystals in the air tended to make the light shaft appear diffuse at a distance.

Besides the staking, leveling and measuring, the ground had to be examined and a profile made. A passage 30 ft. wide had to be cut through the forest to protect the ropeway from falling trees. Considerable land had to be acquired. Applications for expropriation were filed as the work proceeded.

Contract Is Signed

In February 1942 the Government agreed to a provisional increase in the price of copper which gave the Boliden company the necessary aid for financing the undertaking. The contract with Nordströms was signed in April, the mining company taking charge of the work and making itself responsible for transporting men and materials, and for preparing quarters for the entire force, which rose to 1500.

Roads had to be built. They included 4½ miles of corduroy laid over sodden stretches, 8 miles of pine-rusk ways on top of moraine gravel beds, and two power-driven windlass ways, which ascended the slopes of two mountains, taking loads up to 6 tons. The gradient was 30% ft. and the respective distances were 660 and 330 ft.

Power lines were run to driving stations and to power windlasses, and transformers were set up. Special arrangements were necessary where the ropeway crossed public roads, railway lines, and existing power lines, the last being crossed 11 times. Protective nets were provided in 10 instances.

Erecting the "Towers"

Concrete used in construction totaled 850,000 cu.ft. Steel for reinforcement amounted to 1100 tons.

Foundation for masts standing on solid ground was in general good and piling was required only for three columns standing in an extensive moor. Another difficult job was the foundation work for 16 masts standing in water, 13 of them in Lake Mensträsk, where the depth varied from 11 to 45 ft. and the bottom was covered with mud and sticky marl.

Foundation plates were made from so-called E-cement, which is considered good enough for most building work. Allowances of A-cement, which was rationed at the time, were granted for the pedestals and masts. All concrete mortar was subjected to vibration tests.

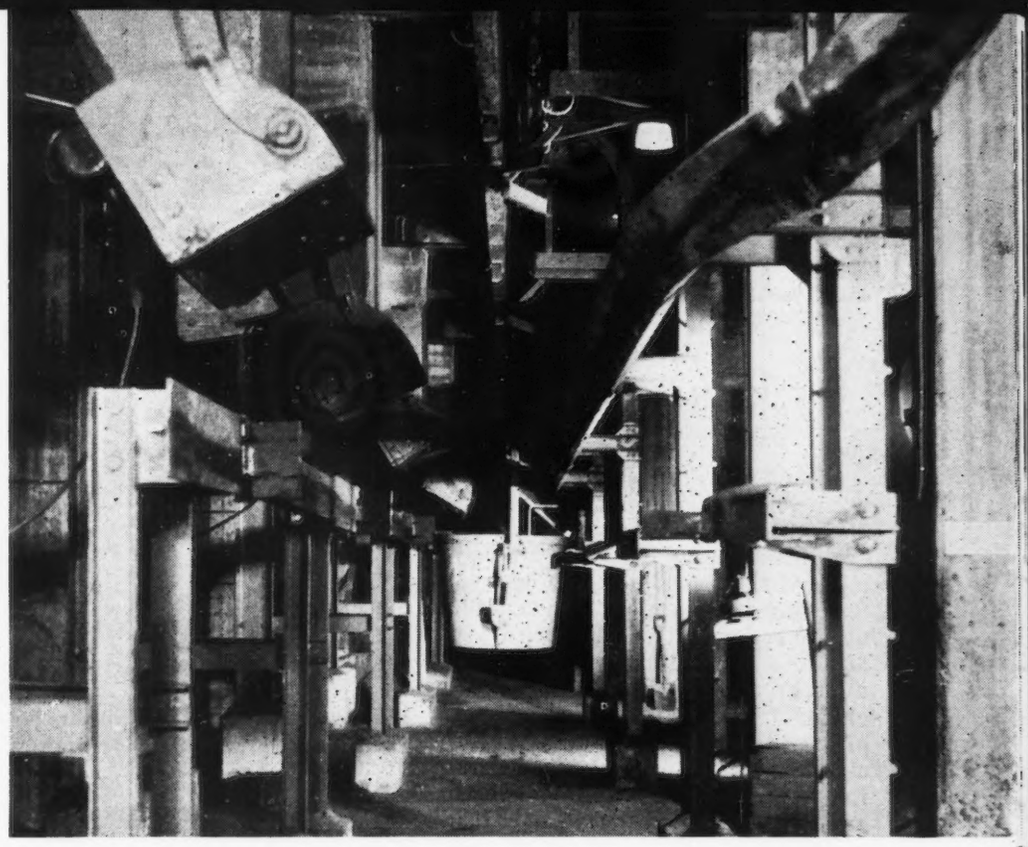
Some of the columns were cast in a steel-plate mold with a tube from the top, the vibrator being inserted through the side of the mold. Other columns were cast in wooden molds, which were extended as the casting proceeded. The hollow part of the 125-ft. masts was cast in a sliding mold. It was difficult to get the reinforcement steel needed in time.

Steel Work Started

By mid-July, 6 miles of concrete work was finished, including 3⅓ miles from Bjurfors towards Boliden and 2½ miles in the same direction from Strömfors. The ropeway company's engineers and erecting force were then able to begin erection of steel structures and to fit mountings on masts and to install the driving machinery and electrical equipment.

To do all this, any delay in the schedule had to be avoided, lest it block the work of the follow-up gang. Work in the shops moreover had to be co-ordinated with the field work. The supply of structural steel and steel castings decided the rate of construction. Substantial priority was obtained, which helped.

As soon as the foundations were ready the steel workers and plate layers arrived with hoists and riveting machines. All parts having been cut to size, assembling and erection could be done quickly. The first to arrive after a mast was ready was the gang that had to erect the telephone line; then the workers who hoisted up the cable shoes and, after them, the cable layers who fed out the cables from a reel. The arms for the hauling rope and platform for the hauling-rope rollers were next fitted into place.



LOADING A BUCKET at Kristineberg station. The container has a lid to prevent dried concentrate from being wetted by snow or moisture.

The Ropes

The cables are joined together with sockets of such shape that the carrier wheel can roll over them without hindrance. Special gangs tautened the carrying cables and wire ropes and did the splicing. The cables of each section are divided into four or five tautening lengths, each with a tension station. The endless hauling rope, however, runs through an entire section without a break, which involves lengths of 22,000 to 26,000 yd.

Tension of the carrying cables is automatically regulated, independently of the load, by means of heavy concrete weights at the tension stations. The tension of each hauling rope is regulated by a weight at every driving station sliding in a vertical guide.

Job Completed—First Trip

Tramway construction was finally completed. Trial runs took place on the first section, from Bjurfors to Boliden, on Feb. 26, 1943, and on April 14 that year the first carrier, decorated with flags, made the whole trip from Boliden to Kristineberg.

The ropeway was ready for delivery a year and five days after the contract was signed, which was four and a half months ahead of the stipulated time. The construction rate was about 5 miles a month. This performance in building a tramway through the wilds of Lapland, with its severe winter, is considered a record.

Owing to a sudden thaw which made roads temporarily unusable the new ropeway was put into commission immediately at full capacity instead of being run in gradually while adjustments were being made. From May 7, 1943, on, it has operated continuously 24 hours a day.

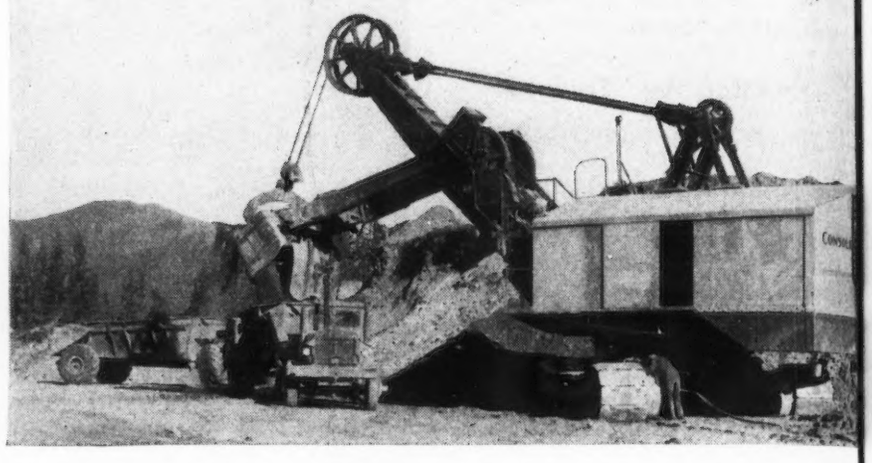
New Advantages Realized

With this tramway it became economically possible to ship pyrites from the Kristineberg district, where it had been classed as waste, this although Sweden normally imports 250,000 tons and more of pyrites for its sulphur.

The decrease in transportation costs more than offset the high construction cost. Seventy-five percent of the cost of transportation with the ropeway consists of amortization and interest payments on the investment. When the first cost has been written off, the transport cost will have been reduced to one-quarter of that with trucks.

Heavy Equipment Handles Backfill at Sullivan

JOHN B. HUTTL
Associate Editor



GLACIAL TILL FOR BACKFILLING is mined by this 6½-yd. electric shovel and transported to the collar of fill raises in 13-yd. bottom-dump trucks

THE TONNAGE of glacial till handled recently to fill work-out underground areas at the Sullivan mine of the Consolidated Mining & Smelting Company of Canada, Ltd., at Kimberley, B.C., has equaled and at times surpassed ore production underground. Filling is practical chiefly to permit future extraction of ore pillars, and to minimize subsidence, except in areas where caving is desirable. Following investigations of methods at Mount Lyell, Australia, and in Pennsylvania coal-mining areas, backfilling was started in 1934. The volume of backfilling increased from 63,400 cu.yd. in 1935 to 1,612,450 cu.yd. in 1944. Up to Dec. 31, 1945, the amount of gravel moved on the surface totaled 4,460,156 cu.yd. All surface filling operations are suspended during winter months, and the actual working season never exceeds seven months.

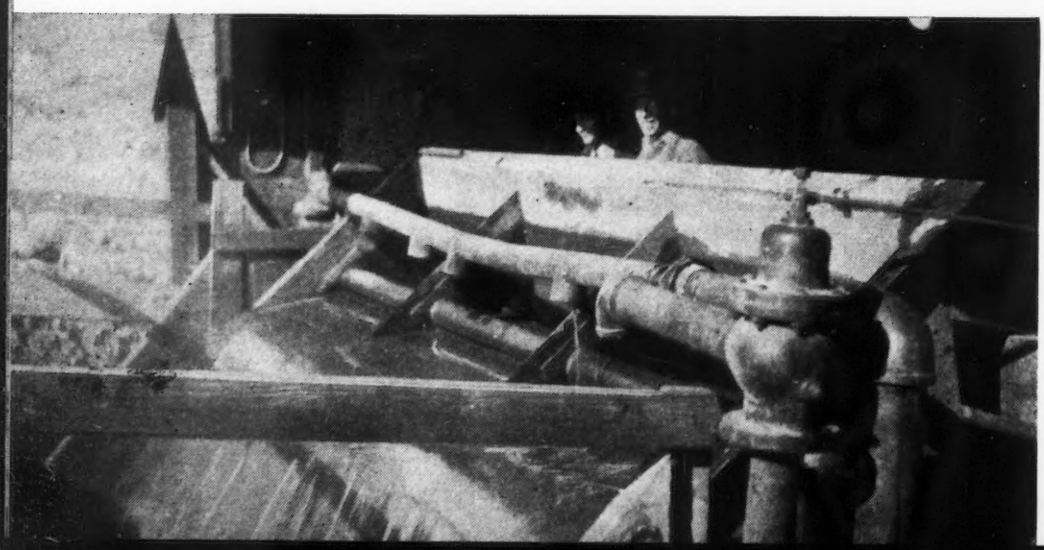
The Sullivan ores are essentially replacement deposits in the Aldridge argillaceous quartzite of Pre-Cambrian age, occurring conformably with the beds in a general way, but possessing some of the features of a vein. The orebodies are large, massive deposits, ranging up to 265 ft. in thickness in places. Save for local irregularities, the dip of the deposit averages about 20 deg. above the 3,900 level, and steepens to almost 40 deg. below this level. Though the footwall of the vein is fairly regular, the hanging wall is folded, and upper limits require exploration.

The Sullivan mine is developed through a 10x12-ft. adit 7,000 ft. long, known as the 3,900 tunnel, and at an altitude of about 3,900 ft. It extends northerly from the portal above Mark Creek in the quartzite in the footwall to the lode at the north orebody, with a drift extension of more than 4,500 ft. in or immediately beneath the ore. In recent years, a substantial tonnage of ore has been developed and is being mined below the 3,900 level, with an inclined shaft affording access to this new section. Production from this area is transported to the main haulage level, the 3,900, by means of an underground belt-conveyor installation.

Ore in the area above the 3,900 level in general is mined by a combination glory-hole and room-and-pillar method. The section to be mined is laid out in alternate pillar and stope areas, the dimensions of which are largely determined by the thickness of the orebody. In general, they are 50 ft. wide and 200 ft. long. Below the 3,900 level, the ore is mined by blast-hole methods. See *E.&M.J.*, March 1946.

Current backfill work is confined largely to worked-out areas above the 3,900 level. Some of the openings in the area between 4,600 level and the outcrop have been filled by forced caving brought about by removal of ore pillars. The bulk of stope fill, however, is gravel moved from the surface and introduced to the open areas through inclined raises and shafts extending from the highest point of the hanging wall to the surface. Because of the small amount of development work done, little waste rock for filling is available.

At Kimberley, Dame Nature has acted most generously in creating one of the largest lead-zinc deposits in the world and covering it with ample glacial till of suitable quality for filling stopes. Quantity and quality of gravel were determined from the recorded data on overburden from previous surface diamond drilling, and by sinking test pits. Mate-



PIVOTED STEEL MEASURING TROUGH filled with water is emptied at the same moment contents of truck are dumped into raise. Ideal ratio is 25 gallons of water to one yard of gravel.

rial satisfactory for filling large stopes has been found to be that containing less than 10 percent clay.

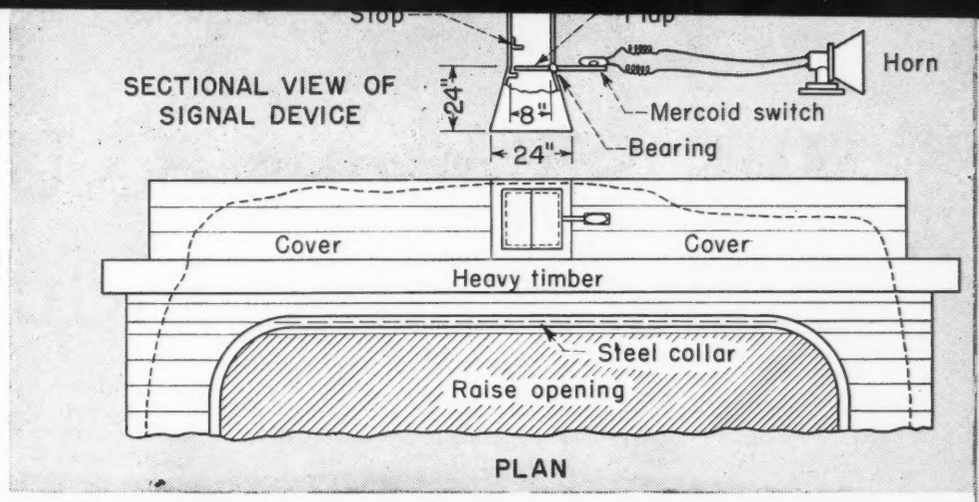
An average screen analysis of suitable gravel is as follows:

Size	Percent
+ ¼ in.	50.00
– ¼ in. + 20 mesh	21.98
– 65 + 100 mesh	16.19
– 100 + 150 mesh	2.07
– 150 + 200 mesh	1.24
– 200 mesh	8.52

Selected and tested gravel areas are worked by open-pit methods. Roads connect the pits with raises and shafts leading underground and are laid out on the flattest grades possible. To insure speedy truck operations and reduce tire wear, road maintenance work receives special attention. During the summer months calcium chloride is used on the roads in addition to frequent sprinkling with water wagons to minimize dusting. Until 1943, practically all filling was done with bulldozers and a 12-yd. LeTourneau Carryall. This equipment is now used only to handle the gravel near a raise or shaft until the ground is more or less leveled to the surface of solid rock. It also serves for road building and general clean-up work. Currently, the bulk of gravel is mined by a 6½-yd. electric shovel and transported to the shafts in 13-yd. bottom-dump Euclid trucks.

Gravel lying at a considerable elevation above the raise collar is sluiced to the raise. In one such instance, where more than 1,000,000 yd. of gravel lay 100 to 150 ft. above the collar of the raise, a dump ramp was built at pit elevation, followed by excavation of a 4-ft. ditch between the ramp and the raise below. The best sluicing results were obtained with a ditch on a 15 deg. slope.

Gravel brought to the collar for dumping is conditioned by adding predetermined quantities of water. By maintaining a proper ratio of water to gravel, the material can be made to flow distances up to 1,500 ft. on comparatively flat grades in stopes. In general, about 25 gal. of water per yard of gravel, or 250 gal. per truckload of 10 yd., are used. Water is added to the gravel by means of a measuring trough installed at the collar of each raise. See accompanying illustration. It consists of a long, steel-braced trough, a shaft made from pipe with a hand crank at one end, and the water-supply pipe system with valves and pressure-release units. The filled trough is emptied when truck contents are dumped into the raise.



SIGNAL DEVICE AT SIDE OF MOUTH OF RAISE indicates a choked raise. Back draft produced when gravel is dumped into choked raise lifts flap which tips mercoid switch and closes electrical circuit to sound off a warning blast of horn.

Water for backfilling operations is obtained from Lois Creek dam and accumulated mine water. The Lois Creek water supply system consists of an 8,000-ft., 6-in. pipe line, and a six-stage I-R centrifugal pump operating against a 1,200-ft. head. The mine water is pumped from the 3,900 level by an Allis-Chalmers four-stage centrifugal pump through a 580-ft. diamond-drill hole 4½-in. in diameter, and a 5-in. pipe line 4,500 ft. long to a 50,000-gal. storage tank. This tank also receives the water pumped from Lois Creek. Both pumps are powered by 150-hp. motors. From the general storage tank the water is piped to the different filling sites.

The raises through which gravel is introduced to the open stopes measure 8x16 ft. and the shafts passing through gravel, 8x10 ft. Raises average 600 ft. in length. In general, the raises are driven on a 75-deg. slope, so that they will hole through on the down-hill side of the gravel deposits. Driving and timbering of these raises differs little from the methods used in other standard mine raises. The upper part of the raise usually is sunk through 30 to 100 ft. of overburden, and timbered in the conventional manner of temporary shafts in gravel. Before filling operations start all timber is blasted out of the raise in rock. Shaft timber is removed as the level of the gravel around the collar is lowered.

At one side of the mouth of each raise is the simple signaling device explained in the accompanying sketch and caption, to record any choking in the raise. It consists of a wood housing measuring 24x24 in. at the base and 8x8 in. at the top, with a total height of 24 in., and a pivoted flap and mercoid arrangement covered by a small roof. Any back draft resulting from dumping gravel when the raise is choked automatically lifts the flap to the stop indicated, thereby tipping the mercoid and setting off a horn blast.

Equipment for Backfilling

One Bucyrus-Erie 170-B electric shovel with a 6½-yd. dipper
Ten Model F 13-yd., bottom-dump Euclid trucks powered with 150-hp. Cummins diesel engines
Five Caterpillar D-8 tractors equipped with Carco bulldozer blades
One 12-yd. LeTourneau Carryall
One heavy rooter
One Caterpillar Model 12 road grader

Servicing and refueling of equipment, and light repairs, are done at a central shop maintained in the backfill area. Here also is a 10,000-gal. fuel storage tank. Diesel oil received at the Canadian Pacific rail point is pumped to this tank through a 1-in. pipe line against a head of some 1,200 ft.

The yardage of gravel required for filling through each raise is estimated from mine plans and sections, and pits and working methods are laid out accordingly. At the end of each month all active gravel pits are surveyed to calculate the yardage of gravel removed. Underground, all bulkheads covering the low parts in the stope are made from concrete, and contain six 2-in. drain pipes.

Appreciation is herewith expressed to R. W. Diamond, vice president and general manager, Consolidated Mining & Smelting Company of Canada, Ltd., for permission to publish this article, and to H. B. Gilliland, engineer in charge of backfilling operations, for help in assembling data. The courtesies of J. R. Giegerich, mine superintendent, and members of his staff including Messrs. Campbell, Chisholm, Bloomer, and Armstrong are also gratefully acknowledged.

Will Silicones Be Useful In the Mining Industry?

MEMBERS of the new silicone family of synthetic polymers are all characterized by exceptional heat stability, waterproofness, water repellency, oxidation and corrosion resistance, and electrical non-conductivity. It appears, therefore, that the basic properties of silicone products are those required in materials suitable for use under the severe service conditions to which mechanical and electrical equipment are subjected in mines, mills, and smelters.

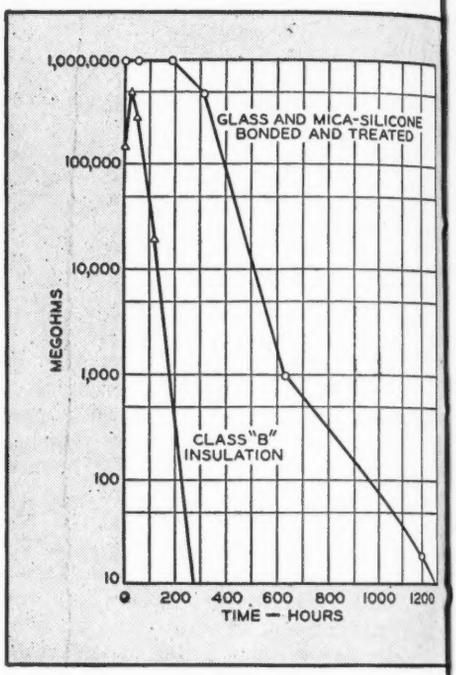
Reports[1] on the accelerated-life testing of silicone insulated motors alternately subjected for thousands of hours to operating temperatures of 590 deg. F. by resistance and exposure to 100 percent relative humidity, indicate that silicone materials may well be of great interest to men in the mining, milling, and smelting industries.

This article outlines the major characteristics of some of the new silicone products which have emerged from the laboratory stage and are being produced in commercial quantities for use as lubricants, insulating materials, and heat and corrosion resistant coatings and compounds. Already many silicones in the form of resins, plastics, paints, insulating varnishes, fluids, compounds, greases, and elastics are available for use in industry.

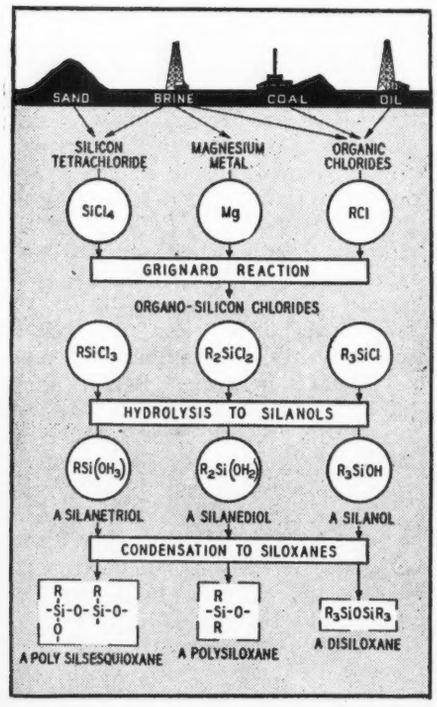
The accompanying flow chart indicates the general procedure in the preparation of these polymers. The primary raw materials, sand, brine, coal, and oil, are processed into organo-silicon-chlorides. The "organo" group, here represented by "R" in the chart, may be any one of a large number of hydrocarbon groups obtained from coal and oil, such as methyl, ethyl, or phenyl. The organo-silicon-chlorides are then hydrolyzed and condensed into organo-silicon-oxides, the large molecules from which the silicone polymers are built up. Note that the resulting silicones are partly organic and partly inorganic, and for the purposes of industry they seem to combine the best properties of each group.

The extraordinary stability of the silicones, as compared to analogous organic hydrocarbons, is due to the attachment of inorganic silicon atoms to oxygen atoms. This "bond" is more durable than the carbon-to-carbon linkage, and enables silicones to withstand greater heat and offer greater resistance to moisture, high voltages, and corrosives. Water-repellent properties are due to the arrangement of the organic groups on the "outside" of the molecules—presenting, as it were, an insoluble surface to the water, such as that of paraffin or oil.

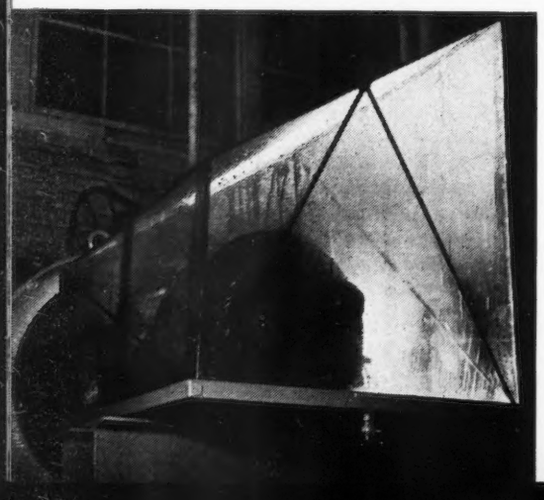
Because of the following three variables which enter into the manufacture of silicones, the number of compounds which can be produced is virtually infinite: (1) The organic group (R) attached to the silicone may be chosen at will, and with each choice a different silicone is produced. (2) Likewise length of the chain of Si-O-Si links may be allowed to grow to almost any length, resulting in a product which is more fluid than water or more viscous than vaseline. (3) Finally, special types



SUSTAINED HIGH HUMIDITIES cause the resistance of the conventional type of insulation to drop much more rapidly than that of the silicone insulation.



IN THE PREPARATION OF SILICONES, silicon and oxygen are linked with an organic component (R) to form a variety of new and useful products.



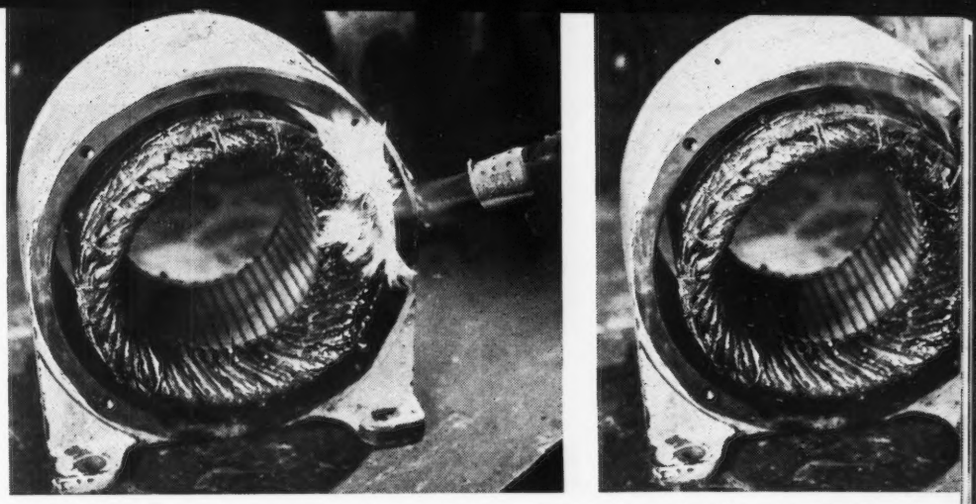
THESE TENTS are used to keep moisture in, so that the silicone insulation with which these test motors are wound can be repeatedly saturated with moisture to test the life expectancy of this new class of insulation.

[1] "Organo-Silicon Compounds for Insulating Electrical Machines." T. A. Kauppi and G. L. Moses, AIEE Technical Paper 45-30. Dec. 1944.
"The Application of Silicone Resins to Insulation for Electric Machinery." J. DeKiep, L. R. Hill, G. L. Moses. AIEE Technical Paper 45-23. Dec. 1944.
"Results of Tests of Silicone-Insulated Motors." T. A. Kauppi, George Grant, G. L. Moses, and R. F. Horrell, Westinghouse Engineer. Sept. 1945.

of silicones can be manufactured by "cross-linking" one long molecule to another, forming three-dimensional structures of endless variety.

Although silicones cannot as yet compete generally with hydrocarbons in price, and much experimental work remains to be done, the industrial possibilities of silicones are attractive. In fact, two producers are already in the field, Dow Corning Corporation, and the General Electric Co.; and others who are promoting the applications of silicones include the Mellon Institute, Corning Glass Works, Dow Chemical Co., Westinghouse Electric Corporation, and National Electric Coil Co.

Silicone products fall into three main groups—liquids, resins, and rubber. Outstanding characteristics of each group and important uses are as follows:



FIVE SECONDS after the flame of a blow torch is turned away from the silicone insulated windings of a motor stator, the flame dies out. As fires can occur in electrical equipment in the best of mine plants, this new means of fire prevention warrants serious consideration.

Liquids. The liquid silicones are long-chain molecules without cross links. They can be produced with any viscosity, and that viscosity remains very nearly constant over wide temperature ranges. They are temperature-stable and water repellent and resist attacks by oxidizing solutions, mineral acids, salts, and alkalies. They will not damage plastics, metals or natural or synthetic rubber. They have low vapor pressures and a flat meniscus.

The liquids are finding applications in industry in hydraulic machines, in waterproofing, and as lubricants. They are used in manometers and compasses, in torsional vibration dampers, in temperature baths, as lubrication oils for instruments, as high-vacuum diffusion-pump oils, as damping fluids in precision instruments to prevent vibration of indicators and pointers, as foam inhibitors, especially in diesel oils, and as liquid dielectrics. Ceramic insulators, used extensively in electrical equipment, are treated with silicone fluids to make them water repellent and thus to eliminate short-circuits caused by moisture films. Similarly, glass, paper, and cotton may be treated to make them water repellent. Used in hydraulic systems, the silicone liquids provide a marked advantage over the commonly used petroleum oils. They will not thicken at –70 deg. F. nor will they thin out at 300 deg.

The greases and pastes maintain their consistency (which is about that of petrolatum) throughout the range of temperatures from 40 deg. below zero to 400 deg. above.

These more viscous compounds find use in high- and low-temperature bearing lubrication, in sealing and waterproofing compounds for ignition systems, in greases for ceramic and glass stopcocks, and in greases for pressure-lubricated valves exposed to high heat or chemical corrosion.

Resins. The resins have all the valuable general properties of the silicone family. They are produced as varnish-like liquids, but polymerize to solids when heated to 160-195 deg. F. for a few hours and thereafter cured for several more hours at 300 deg. F. The tangle of intermolecular bonds becomes so great that the final substance is either a brittle or a flexible solid, depending on the organic group used.

The chief use of the resins so far has been in high-temperature insulation. Applied as a liquid to Fiberglas or asbestos, and then baked, the resin forms a permanent impregnant that repels water and resists heat far better than organic varnishes. Similarly, they are used to enamel magnet wire, and to bond fiber board and mica. These bonded materials do not track or carbonize on flashover. Another interesting use is as a vehicle for heat-resistant paint for use on exhaust stacks, mufflers, flues, hot-air ducts, and ovens. Suitable pigments for these paints, particularly in some colors, are as yet an unsolved problem.

Elastomers. The third group of silicones contains flexible and resilient members which are remarkably like rubber in elasticity. These silicone elastics have the same softness and resiliency as common rubber, but retain these characteristics over a wider range of temperatures. They will withstand continued exposure to 30 deg F. and long exposure to 575 deg., where ordinary rubber is limited to 185 deg. The silicone elastics are waterproof and do not swell in oil, aqueous, neutral, or ammoniacal reagents, strong sodium hydroxide solutions, or polar solvents. They are arc-resisting, non-tracking, and retain their flexibility down to temperatures as low as –70 deg. F. Ozone, corona, and ultra-violet light will not damage them, but will ruin common rubber.

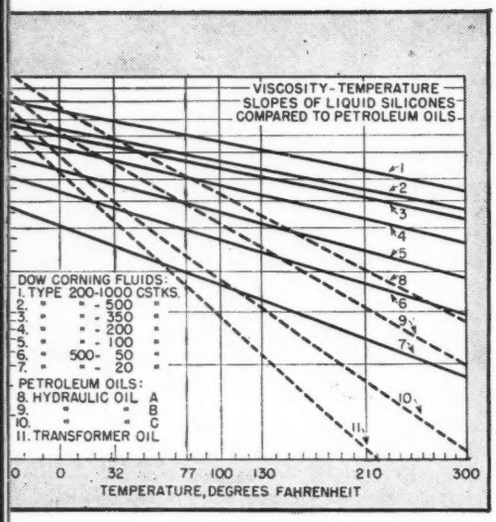
The main uses for the rubberlike materials so far are in wire and cable covering, in molded or extruded gaskets which must withstand wide changes of temperature and humidity, in vibration mountings, and in flexible insulating coatings for wire-wound resistors, Fiberglas tape, and conveyor belts.

One unusual silicone known as "bouncing putty" can be pulled like taffy (if the pull is exerted slowly) into a long thin thread. On the other hand, if it is pulled suddenly, it breaks like pasticine or putty. Left to itself, it will flow very slowly; rolled into a ball it will bounce. This particuar member is being considered for possible application.

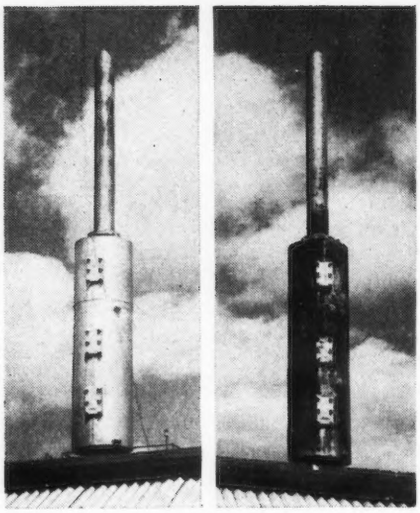
Silicones as Insulators

As a large proportion of the electrical equipment used in the mining industry must be exposed to extreme humidity and heat, silicone resins, used as insulators, would seem to offer substantial help.

Ordinary organic impregnating resins and varnishes will exclude water as long as they are not subjected to high temperatures at the same time. Under conditions of unusual heat, however, they normally crack and carbonize, thus becoming conductors instead of insulators. Silicone resins and varnishes resist both heat and moisture, and actually complement inorganic insulating


VISCOSITY-TEMPERATURE
SLOPES OF LIQUID SILICONES
COMPARED TO PETROLEUM OILS
DOW CORNING FLUIDS:
1. TYPE 200-1000 CSTKS.
2. " " - 500 "
3. " " - 350 "
4. " " - 200 "
5. " " - 100 "
6. " 500- 50 "
7. " " - 20 "
PETROLEUM OILS:
8. HYDRAULIC OIL A
9. " " B
10. " " C
11. TRANSFORMER OIL
0 0 32 77 100 130 210 300
TEMPERATURE, DEGREES FAHRENHEIT

SILICONE FLUIDS have a more uniform viscosity (measured in centistokes) than petroleum oils. Note temperature range.



Diesel exhaust muffler at left was painted more than 18 months ago with heat-resistant silicone paint, pigmented with aluminum. On the same day, the badly rusted muffler on the right was painted with conventional aluminum paint. Both mufflers were exposed to surface temperatures of 510 deg. F. in a humid atmosphere laden with fumes.

materials, like Fiberglas, asbestos, and mica, because they are built on a similar inorganic framework.

The silicone insulating varnish is applied and handled exactly as conventional organic varnishes are applied. A curing process converts the silicone into a hard but flexible resin which seals the equipment against moisture. In this way it is used in motors to bond Fiberglas or asbestos served magnetic wire, to varnish Fiberglas or asbestos tapes, cloths, and sleeving, and as an adhesive for bonding mica sheets to silicone-varnished Fiberglas cloth in the production of a flexible ground insulation. Finally, the whole assembly is impregnated.

Induction motors and d.c. traction motors, thus insulated, have been tested under severe conditions. Heavy vibration, extreme heat produced by overloading, and moisture saturation, all fail to impair seriously the effectiveness of the silicone insulation. For some specific results, see accompanying illustrations. If the new silicones fulfill the promises of these tests, they will find use in locomotives, substations, ventilation motors, transmission lines, and other underground equipment. If electric motors must operate under excessive temperatures, due either to their own loads or to their proximity to hot equipment such as diesel engines, rotary kilns, or roasters, they will function more reliably if the silicone products are used. Likewise, if motors are subjected to excessive humidity as in mines, silicone insulation will afford more reliable operation because the silicone resin film has a lower rate of moisture absorption and is water repellent as well as waterproof.

Silicone insulation does not support combustion. Consequently, fire hazards attendant upon the failure of conventional organic insulation are eliminated. As the resins are not deteriorated by petroleum lubricants, damage to motors due to carelessness of mechanics during oiling will be reduced.

Silicones as Lubricants

Although the use of silicones has not been as widely explored for lubrication as for insulation purposes, several unusual properties of the silicone lubricants suggest their consideration for use in the mining industry.

In the lubrication of bearings, for example, the organic lubricants are subject to oxidation at the high temperatures produced by rapid rotation or by high ambient temperatures. As a result they produce organic acids that are corrosive to the bearing metals. Silicone greases used here would not decompose under the abnormal heat, and they would retain their consistency, effectively keeping out dirt and moisture and any corrosive gases near the equipment.

As lubrication for oven machinery, and for rotating parts near high temperatures, the silicones might be of excellent service. In rock drills, where fluids are needed to resist water and oxidation, and to protect moving parts against wear and rust, the silicones could probably be used. They would keep the ratchet pawls and valves free from gummy deposits. In compressors the valves must remain free from oxidation products formed by the high discharge temperatures. Here the silicones may have practical value. The tendency of hoisting ropes to spatter cable "dope" around when surface temperatures rise might possibly be eliminated by developing a suitable, uniformly viscous silicone lubricant.

Silicones as Anti-corrosion Materials

The ability of the silicones to withstand the corrosive action of chemicals, even at elevated temperatures, suggests that they could alleviate other operating difficulties in the mining industry. In electrolytic plants where metals are precipitated from caustic or acid solutions, much pumping of corrosive solutions is necessary. For such service, it is possible that satisfactory silicone linings for conduits and special silicone packings for pumps might be developed. Likewise, metal parts of stacks and buildings which are exposed to acid fumes in smelters or refineries, and which are difficult to protect with other coatings, might be preserved with special types of silicone paints.

As the industrial applications of silicones are still largely in the experimental stage, it is too early to predict whether these products will compete with or stimulate the consumption of metals and nonmetallics. For instance, it is possible that if low enough prices are established for silicone resins, they may compete with galvanizing or other protective coatings for special purposes. On the other hand, the successful use of aluminum dust with silicone resins to protect hot surfaces from deterioration might indicate a new outlet for metallic powders including zinc. Similarly, one silicone product, a bonded mica glass, may provide an appreciable market for scrap mica, whereas a similar product with high dielectric strength may compete with sheet mica. If there is widespread demand for the resin-impregnated asbestos now being made, the demand for short-fiber asbestos may be affected somewhat. The probability at present is that the technological advantages offered by silicone products will outweigh competition which these products might introduce in the marketing of mine products.

Stay With It, Squares!

R. H. RAMSEY, Associate Editor

FOLLOWING some weeks of fasting and meditation, upon which I entered when Mr. Just dropped Mr. Rose's manuscript on my desk, I can only say that I find no real area of disagreement between the views expressed in our editorial of March 1944 and those set forth in Mr. Rose's article in last month's *E.&M.J.* There is, perhaps, some misunderstanding which I hope to clear up in this discussion.

Mr. Rose said that present flotation machines seemed to have reached a maximum in size, and that further increases in dimensions would entail undue sacrifice in metallurgy or in power costs. There can be no argument on that point. To quote from our editorial, "When we spoke for larger cells, we took it as self-evident that the larger cells must be re-designed." Thus we had agreed in advance that the cubes, as Mr. Rose aptly puts it, have for the moment fought the squares to a standstill.

Time to Attack

This being so, our view was that it is time to attack on a new front. But in the light of Mr. Rose's skepticism on the value of a larger cell, let us consider whether or not there is a place for a bigger, but fully effective, flotation cell.

Mr. Rose offers a table showing the number of cells of various sizes that would be used in a mill requiring 1,000 cu.ft. of total cell volume. His calculations show that no significant economy would result from using cells larger than 100 cu.ft. per cell.

Again there can be no argument, but it must be noted that a mill requiring 1,000 cu.ft. of cell volume would be in the range of 500 to 1,000 tons per day, far below the size of the mills that could possibly be interested in a really large flotation cell. Probability of short-circuiting of pulp and need for flexibility of flowsheet would dictate that in this case at least 15 to 20 cells should be used. Here, 50- to 100-cu.ft. cells are quite big enough.

Place for Big Cells

When we referred to "large mills" as users of "big" machines, we should have been more specific. By "large" we meant mills of 10,000 tons and up, and in this range, Mr. Rose's own tabulation will show that opportunities exist for real savings in number of units, maintenance, power, floor space, and supervision. A revision of his table based on 25,000 cu.ft. of cell volume is appended herewith. For a mill as large as the proposed Chuquicamata concentrator, or the giant mills talked about in the Iron Country, the opportunities for 200-cu.ft. cells would be even greater.

Can an effective machine larger than 100 cu.ft. be built? My best answer to that question is that I once assisted in considerable test work that gave promise of developing such a machine. Even in an elementary stage, the 12-in. impeller being tested rendered effective (air-swept) a cell volume of about 150 cu.ft., and if work had been carried further, this volume could have been increased or the aeration intensified.

Although I would not presume to attempt a detailed analysis of possibilities for improved design in larger machines, one or two such elements almost suggest themselves. For example, as Mr. Rose points out, there is no value in merely increasing present impeller diameters, because rate of air input drops off and power rises, both sharply. But there is no reason at all why the *area of effectiveness* of impellers cannot still be increased by making them more efficient and effective instead of larger. Mr. Rose has speculated upon flotation as a power process, but no one has yet reported on the sort of intensive study required to determine how to apply power in flotation most effectively, most economically, and on a large scale. Impeller design would play a large part in such a study, chiefly because so little is known about impeller functions. The squares can't quit yet; they haven't really begun to fight.

New Ideas Needed

There are not even conclusive data available on how mineral particles actually get from the pulp body into the froth. Do air bubbles pick up smaller particles, or do the particles collect air bubbles smaller than themselves? Or do the air bubbles just grow in the right places? Probably an investigator should rid himself of preconceived ideas of what a flotation machine ought to look like and should then set about determining what it is the machine ought to do and how best it can be done.

In short, I am suggesting here not only a search for an effective 200-cu.ft. flotation cell for use in plus-10,000-ton mills, but also a search for a better means of effecting flotation in cells of all sizes. The domestic mining industry in 1944 treated about 144,000,000 tons of ore by flotation and in doing so expended well over 250,000,000 kwh. of power on the flotation machines alone. Any machine that important to mining should be subjected to constant scrutiny aimed at improved efficiency and effectiveness. That is, after all, the main point of this discussion, and upon it, I am sure, Mr. Rose and myself are in complete agreement.

Number of Cells of Given Size to Total 25,000 Cu.Ft. of Flotation Machine Volume

Vol. of Cell, Cu. Ft.	No. of Cells Required	Saving in No. of Cells Compared With Preceding Size
1	25,000	.....
10	2,500	22,500
50	500	2,000
100	250	250
200	125	125
500	50	75
1000	25	25

Slack-Line Scraper Used for Open Pit

CARL K. CARMEAN, Mining Engineer, Webb City, Mo., and
HOWARD O. GRAY, Mining Reporter, the Joplin Globe

F. W. (MIKE) EVANS, veteran Tri-State mine operator, with the assistance of Carl K. Carmean, has again displayed his ingenuity by the introduction of novel open-pit mining operations in the Tri-State mining field. This innovation is the installation of a Sauerman slack-line drag-hoist system at the Sucker Flat pit, in the south-central part of Webb City, Mo. This follows closely their taut-line cable skip-hoist installation at the old Peru chimney cave-in, a mile southwest of Baxter Springs, Kan. (*E.&M.J.*, March 1946).

The original development of Sucker Flats as an open-pit mine was done during the war by C. G. and L. M. Cooley, who, as the Cooley Brothers, were dredging alluvial gold deposits at Como, Colo., and Townsend, Mont., when WPB issued its order that stopped gold mining. They mined the known orebody on a portion of the Webb City property and, as they did not care to enter into a further development program, suspended operations in July 1945.

Evans and Carmean still believed in the property and started a drilling campaign to justify their faith. They developed an extension of the ore mined by Cooley Brothers, comprising an estimated 320,000 tons of positive ore and 160,000 tons of probable ore. Carmean pointed out that the Sucker Flat area holds promise of many thousand tons of possible ore that can, by development, be converted into positive ore.

After extensive study of mining methods to suit the physical conditions, it was decided to use equipment manufactured by Sauerman Brothers, Inc., of Chicago. For removing the overburden, a four-cubic-yard Sauerman crescent scraper, with a two-drum Sauerman hoist, powered by a 150-hp. electric motor, is being used. The waste is deposited by the scraper in the mined-out and unused areas of the pit. The ore is dug and conveyed to the receiving hopper by a Sauerman slack-line cableway, which uses a 2½-cu.yd. bucket. The Sauerman hoist is air-controlled and powered with a 200-hp. motor. Two Caterpillar tractors, a D-8 and a D-7, both equipped with LaPlant-Choate hydraulic bulldozers, are used to assist both the scraper and the slack-line cableway in their respective operations.

The overburden consists of soil, clay, and shale. The ore is found in a formation known locally as "soft ground," and is mostly small granular or crystalline sphalerite and galena imbedded in shale, decomposed limestone, or broken flint, sometimes lying around and between limestone boulders. Some blasting is required to loosen these boulders or to reduce them to sizes that can be handled with the bulldozers. The average depth of overburden to be removed is 49 ft. and the average thickness of the ore zone to be removed and treated is 40.6 ft.

A large grizzly over the receiving hopper has, instead of the rails commonly used, specially constructed bars made from 8- or 10-in. channel steel, with 2-in. flanges. One inch is cut off the bottom flange of each channel, and two channels are then welded together at the flange edges, thus forming a keystone-shaped cross-section. The 4-in. top of the keystone cross member is uppermost on the grizzly, which rests at a 45-deg. angle over the top of the receiving hopper. This construction prevents the grizzly from clogging.

From the receiving hopper at the edge of the excavation, into which the slack-line bucket deposits its load, the ore is hauled by truck to a simple washing-concentrating plant. At the plant, some 1,000 ft. from the receiving hopper, the ore is fed into a Bodinson 5x26 revolving trommel screen, which is divided into three sections—the first 5 ft. of the front end being a blind scrubber, the next 16 ft. having ⅝-in. perforated round openings, and the remaining 5 ft. being a blind discharge section. Inside this trommel is a heavy spray of water to help wash the ore. The undersize, minus ⅝ in., goes to a Telsmith twin-screw washer. The coarse product from the second washer is treated on a four-cell 48x54 rougher jig. Overflow from the screw washer goes to a large drag

CLOSE-UP of scraper dumping overburden into path of bulldozer. Span of scraper machine is about 1,000 ft. Part of this 1,000 ft. is "dead" span, as the operating cables have to cross the worked-out pit to the scraper hoist, which is on the far edge of the hole opposite the point where the scraper dumps.

classifier. The classifier sand is treated on a 48x54 four-cell sand rougher jig. The smitten products from both these rougher jigs are given a final concentration over a six-cell 36x48 cleaner jig. The resultant zinc and lead concentrates are sold to local buyers. Overflow water and sands from the drag are passed over another drag classifier and V-tank, where additional values are settled out for treatment over two Perry sludge tables. The oversize from the trommel screen at present is wasted or placed in a pile for future treatment. It is being stockpiled by means of a scraper operated by a two-drum hoist powered by a 50-hp. electric motor. A 5x5-ft. steel tower 50 ft. high, mounted on skids, is used to anchor the sheave block for stacking this material, of which some 100,000 tons is estimated to be already on hand.

Improvements Planned

The entire operation is predicated on handling large tonnages with minimum expense. The present operation is set up to handle 75 tons an hour, or 1,500 tons on a 20-hours-per-day basis of operations. Estimated capacity rating of the Sauerman equipment is 200 tons an hour under most favorable conditions.

Many problems have taxed the operators' ingenuity for a solution, and many improvements are now on the agenda. A few of these are as follows: A steel center-feed receiving hopper; a crushing, sizing, and gravity concentrator addition to treat the trommel screen oversize to recover the values now lost in this material; a flotation plant to treat the gravity zinc concentrates now produced and those that would be produced by the crushing unit above mentioned for the purpose of bringing up the grade by reducing the iron content of the zinc concentrates; an improvement in the pumping installation.

The inflow of water into the bottom of the pit was lowered from 750 to 200 g.p.m. during January and February. This was accomplished by a 12-in. Pomona turbine pump in the old Tarrant shaft, 2,480 ft. from the pit on an adjoining 40-acre lease to the southeast. By churn-drilling, the pump was set to draw from 18 ft. below the bottom of the 226-ft. shaft. As a further precaution against heavy rains raising the water table to the deepest working level in the pit (120 ft.), a drill hole is being put down to a depth of 196 ft. into the old mine workings below the soft ground, and a second Pomona pump will be installed.

IN THE BACKGROUND: The worked-out pit where strippings are dumped. Operating cables of scraper can be seen crossing pit to scraper hoist on far edge of pit. In foreground are operating cables of slack-line cableway and cableway bucket just dropping down into excavation to dig a load of ore. Cableway span is 600 ft.

BUCKET OF SLACK-LINE CABLEWAY digging a load of ore. At extreme left of hopper is operator's station housing the cableway hoist.

Threadless Detachable Bits As Used on Witwatersrand

P. A. CREEWEL, Senior Assistant, Department of Mining Engineering & Surveying, University of the Witwatersrand, Johannesburg, South Africa.

Two types of threadless detachable bits and records of their performance at Witwatersrand gold properties are presented here for operators elsewhere who may not be familiar with these designs.

WITH INCREASING DEPTH of workings at Witwatersrand gold mines and attendant problems of transporting large quantities of drill steel over long distances, operators were compelled to experiment with detachable bits.

The Bedford "Simplon" type was first tried in 1937 with success at Crown Mines, Ltd., and by August, 1939, 110 jackhammers were drilling 3,400 holes daily with this bit. Van Dyk Consolidated, on the East Rand, tried the same bit in 1939 and soon used it for all stoping operations.

With the advent of the war in September 1939 and consequent restrictions on production and shipping, import facilities became more limited. It was, therefore, necessary to keep existing equipment in operation rather than expand development.

Details of the "Simplon" bit, which is patented by John Bedford & Sons, Sheffield, England, are shown in the accompanying drawing. The new blank used on the Rand is 6½ in. long, 1 in. in diameter, and weighs 1½ lb. Connection to the stem is made with a copper-lined tapered socket. The copper lining is deposited electrolytically. Drilling life of the bit in length is 3½ to 3¾ in.; thus it is discarded when 3 to 2¾ in. long. With a loss in length per sharpening of ⅛ in., it should have a capacity of 28 to 30 sharpenings or approximately 95 to 101 ft. drilled.

The stem is made of ⅞ in. hexagon steel and is usually 54 in. long. There is a slight clearance of approximate-

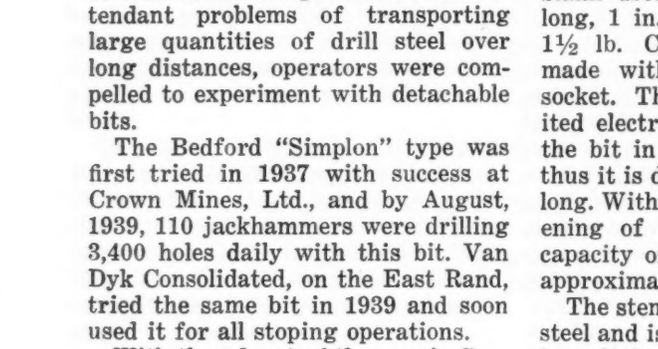
Drilling Figures for the Bedford Bit at Van Dyk Consolidated for 1943

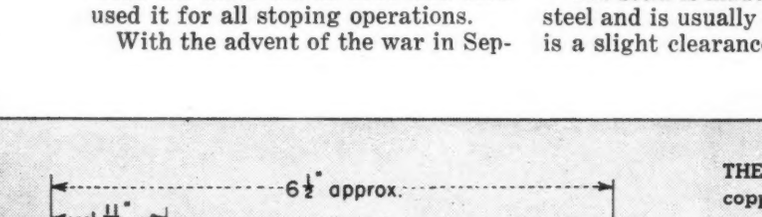
Total footage drilled	4,967,444
Bits issued	86,555
Feet per bit	57.39
Stems issued	18,300
Feet per stem	271.44

Costs for Bedford Stems and Bits at Van Dyk Consolidated for September, 1944

(Fathoms broken, 8,825)	Cost per fathom in shillings
Bits issued 6,254	3.41/-
Stems issued 1,028	1.26/-
Drill sharpening	1.75/-
Percent bits lost per day 0.523	

Note: Value of shilling in terms of U. S. currency for 1944 was 20c. (1 fathom = 6 ft.)



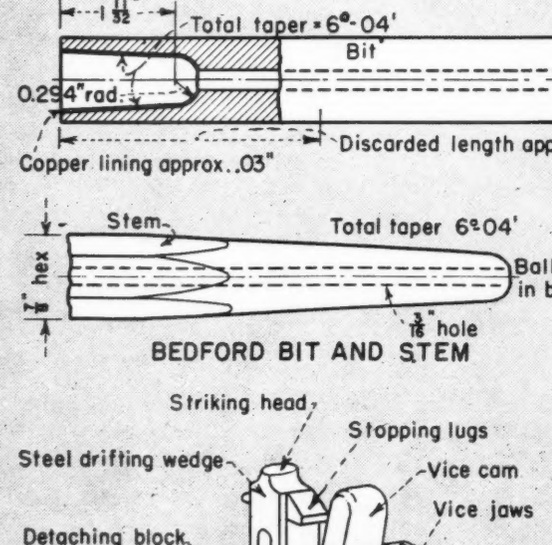


BEDFORD BIT AND STEM

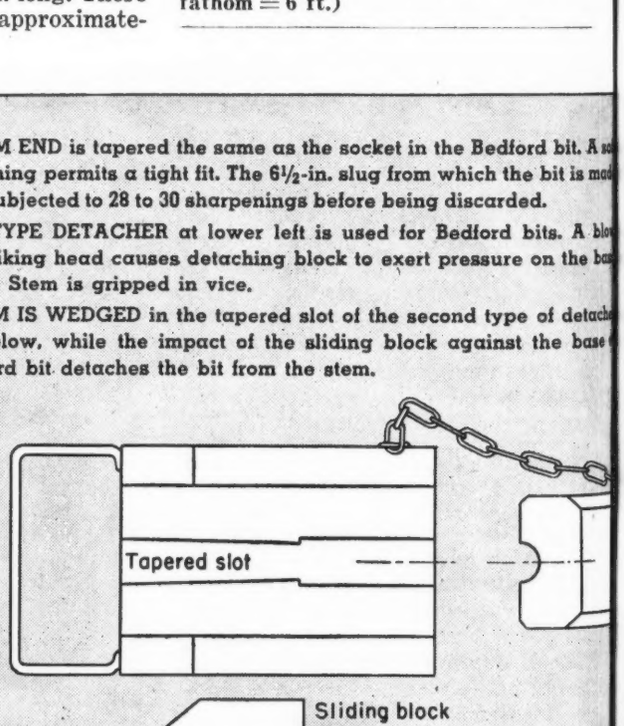
THE STEM END is tapered the same as the socket in the Bedford bit. A s copper lining permits a tight fit. The 6½-in. slug from which the bit is ma may be subjected to 28 to 30 sharpenings before being discarded.

WEDGE-TYPE DETACHER at lower left is used for Bedford bits. A blo on the striking head causes detaching block to exert pressure on the ba of the bit. Stem is gripped in vice.

THE STEM IS WEDGED in the tapered slot of the second type of detach shown below, while the impact of the sliding block against the base the Bedford bit detaches the bit from the stem.



WEDGE-TYPE DETACHER



SLIDING BLOCK-TYPE DETACHER

ly 1/32 in. between the rounded end of the stem and the ball end of the socket. A tight fit between the two components is secured by friction through the medium of the soft copper lining. The bit is attached to the stem by tapping it against the face after the bit has been placed on the stem. Thereafter, the first few blows of the machine produce a tight joint which requires the force of several tons to separate.

Bits are detached by a special machine supplied by the patentees which weighs 50 lb. and requires periodic replacement of wearing parts. One mine, at least, has resorted to a cheaper type which detaches the bit by direct shock effect. See drawings of two types of detachers and Bedford bit and stem.

Shop Equipment Retained

Broken or discarded stems are generally used to hold bits during sharpening and tempering. Most of the furnaces, dollying machines and hot millers in operation for conventional steel have been found suitable for use with the detachable bit, generally without great modification, thus making the installation of special new equipment in drill shops unnecessary.

Breakage and wear of the stem taper is a costly repair, because of the neatness of the fit, which requires precision work. A lathe with a taper-turning attachment is used to form the finished taper after the end of the stem has been subjected to a "roughing" process.

Following success with the Bedford bit, it was thought that a lightweight non-reforgeable bit (one-pass) would be more ideal. The Padley and Morgan, commonly called "P & M" bit, is of this type. It was patented in England in 1938 by Rip-Bits, Ltd., and is manufactured in South Africa under license by the Union Steel Corporation of S. A. (USCO) at Vereeniging. The first bits were manufactured locally in 1939. Initial selling price was 3½ d. each, and has since been increased to 4⅜ d. per bit.

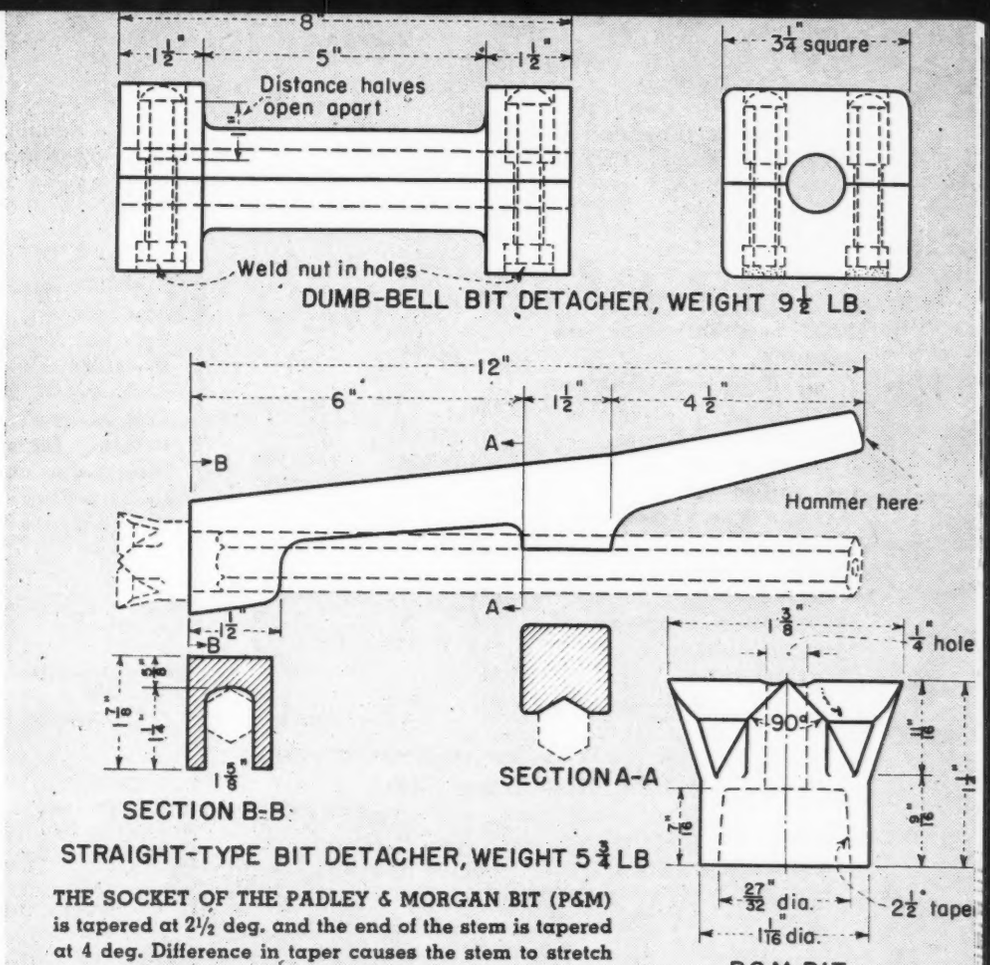
Some of the main troubles encountered in preliminary tests with this bit were: bottoming of the stem taper in the socket causing broken or damaged tapers; splitting of the skirts; loss of bits due to a slight oval shape of many of the sockets. Slight alterations were then made to correct these defects.

The P & M bit used on the Witwatersrand mines weighs 2.75 to 3.54 oz.; it is 1 1/16 to 1⅜ in. in diameter and has an overall length of 1⅛ to 1¼ in. The 2½ deg. tapered socket is 7/16 in. deep with a thickness of "skirt" varying between 7/64 in. and 10/64 in. Bits are detached with a dumb-bell (split) type or straight type bit detacher. See illustrations.

Stems are commonly made of ⅞-in. chrome-molybdenum hexagon steel with ¼-in. axial hole. A suitable length is 63 in. One mine uses 1-in. hexagon alloy steel with unforged shanks. Shanks are generally 6½ in. long with forged collars, this shank having been adopted during the war to replace former rubber-collared shanks. The other end of the stem is tapered at 4 deg. to fit into the bit. The taper is formed by rough grinding and finished off in some form of a semi-automatic lathe. It should be noted that a firm union between stem and bit is produced by the difference in taper of the bit socket and stem end. This causes the stem to stretch the bit skirt, thereby relying on the elasticity of that portion to effect a tight connection.

Although designed as a one-pass bit, operators believed that costs could be further reduced by reconditioning the bit. Initial experiments in which the bits were sharpened by machine and tempered on a plate submerged in 3/16 in. of water yielded encouraging results. Two reconditionings were practicable. It was found, however, that machine sharpening of bits was objectionable because of opening of the skirt of the bit. Thereupon a suitable press was designed, and today it is standard practice to re-press all bits in the same press in which new ones are made. Use of the bits is expanding rapidly for stoping purposes, and some mines are using them with jackhammers for development work.

Many mines have undertaken production and reconditioning of the bits under license from USCO. Essentially the equipment consists of a 200-ton press which is used for forging and repressing the bits. Some 3,000 cold slugs can be cut per hour by means of a shears attached to the press. Cutting of slugs and forging of the bits are not done concurrently at present, but an improved press may be designed to make the two operations simultaneous and at the



THE SOCKET OF THE PADLEY & MORGAN BIT (P&M) is tapered at 2½ deg. and the end of the stem is tapered at 4 deg. Difference in taper causes the stem to stretch the skirt of the bit and effect a tight fit.

TWO HALVES OF THE DUMB-BELL DETACHER for P&M bits may be opened apart to slip over stem. Detacher then slides down stem and knocks off bit. In the straight type of detacher, a blow of a hammer is required to detach the bit as shown.

Results Obtained Under "Run of Mine" Conditions — P&M Bits

	Modder "B" Sept. 1944	Crown Mines Aug. 1944	Consolidated Main Reef Progressive to Sept. 1944
Total new bits made and issued	36,297	364,623	966,855
Total bits reconditioned and issued	49,646	.....	807,781
Total bits issued	84,569	216,491	1,774,636
Holes drilled	64,600	207,281	1,705,646
Feet drilled	204,561	701,300	5,779,667
Depth of hole, inches	38.4	40.6	40.6
Bit efficiency	76.4	95.7	96.2
Bits not accounted for	1998	.....	19,676
Stems issued	6921	.....	11,577
Stems broken or missing	300	.....	9,828
Stem life, feet	681	387	537
Stems retapered	1,446	.....	58,663
Taper life, feet	117	88.2	83

Results Obtained With Test on Reconditioning of P&M Bits — Crown Mines

	Test (A) One Reconditioning	Test (B) Two Reconditionings (100 New Bits Used)	
		1st Recond.	2nd Recond.
Bits reconditioned	16,520	95	80
Feet drilled	51,212	323	248
Depth of hole	38.2	40.8	37.2
Bits lost in hole	474	5	7
Bits efficiency	97.0	94.7	91.3

*Maintenance and depreciation of plant estimated at 0.35 pence per bit not include..

Results Obtained With Reconditioned P&M Bits Under "Run of Mine" Conditions

Langlaagte Estate	Aug.-Sept. 1944 Av. No.	Percent
New bits issued	24,148	100.00
Lost underground	224	0.93
Returned for first resharpening	23,924	99.07
Discarded as unfit for resharpening	1,805	7.48
Resharpened first time	22,119	91.59
Lost underground	602	2.49
Returned for second resharpening	21,517	89.11
Discarded as unfit for resharpening	15,222	63.04
Resharpened second time	6,295	26.07
Lost underground	267	1.11

Cost of Making P&M Bits With Ruling Price of Steel

Mine		Pence
Modder "B"	Cost per new bit. Weight 3.54 oz.	2.52*
	With one re-pressing 90 per cent of bits; cost per bit	1.9
	With two re-pressings 75 per cent of bits; cost per bit	1.7
Consolidated Main Reef	Cost per new bit. Weight 3.70 oz.	2.99
	Cost to re-press each bit once	1.47
	Cost per bit (3 repressings) plus new bit	1.85
Crown Mines	Cost per bit (2,162,945 made or reconditioned)	2.18**

**Depreciation of plant, etc., at 0.27 pence per bit not included. (Present value of the penny in terms of U. S. currency is 1.65c.)

same time save wear on the press.

After the slugs have been heated in an ordinary coal or oil fired furnace, they pass down a chute to the press, and then, while still hot, to a converted sharpening machine which punches out the diaphragm in the water hole. An electric furnace, which is maintained at a constant temperature of 820 deg. C., is used to temper the bits. The bits are automatically fed into and through the furnace, the process taking 25 minutes. On discharge, they are placed by hand with cutting edge downward on a perforated rotating quenching belt passing through a tank of water. A single motor drives the furnace and the belt which is submerged to a depth of ¼ in. The water in the tank is kept at 16 to 20 deg. C. Another tank containing boiling water is situated at the end of the quenching belt, and the bits are fed into the second tank, where they remain for about 20 min., after which they are ready for use.

Advantages gained by the adoption of the detachable bits on the Witwatersrand have been noteworthy. For instance, in one large mine where the Bedford bit was used, in one section of the mine only, breaking 50,400 ft. per month, it is estimated that the labor of nearly 150 natives was saved, each of whom represents a saving of £20 per month. Another mine estimates that labor and expenditures for handling drill steel were reduced by 90 percent. Still another property using the P & M bit estimates a total saving of 1/9 d. per machine shift.

When considering the stems as distinct from the bits, it has been calculated that for 8,000 holes drilled daily, 1.35 tons of P & M stems have to be sent down as compared with 40 tons of conventional steel.

Despite the fact that detachable stems have an average life of six weeks, instead of six months for conventional steel, it has been found that footage drilled per detachable stem far exceeds that obtained from a conventional steel, even though the steel used in both cases is of the same analysis and manufacture.

In view of results with detachable bits on Witwatersrand properties, it seems probable that most of the properties, if not all, will be using them in the future. Currently, it appears that alterations will be along the lines of a bit of minimum weight of comparatively inexpensive but suitable cutting steel, to be used once only and then discarded. However, one of the more expensive alloy steels developed during the war may be utilized, to develop a suitable two-pass bit, which will reduce costs.

At present, tests are planned, or in progress, to use P & M bits with heavier stems for development work with drifters. Shaft sinking with P & M bits is also being contemplated.

Full acknowledgment and thanks are given to the Association of Mine Managers of the Transvaal (Inc.), as well as the individual members, Messrs. Blunt, Ford, Heywood, Hildick-Smith, Lange and Reid, whose courtesy in allowing the writer to make full use of data and illustrations contained in their papers, has aided the preparation of this article.

Combined Lift and Length Feature Charleson Conveyor

V. K. TAIPALE, formerly Chief Engineer, Charleson Iron Mining Co., Virginia, Minn.; now Belting Engineer, B. F. Goodrich Co.

A GREAT IRON-ORE PRODUCER of past years on the Mesabi Range, the Missabe Mountain mine, at Virginia, Minn., is being worked today as a large-scale, so-called "scramming" operation, or one that is being conducted to recover the remaining ore. Use of trucks and a conveyor system have been combined to make possible efficient and low-cost mining. The previous operator, who had held this State lease for 50 years, had mined a total of 66,407,509 tons of iron ore, which yielded $16,604,118.38 in royalties to the State trust fund in addition to the taxes paid.

Mining Method

Four years ago the Charleson Iron Mining Co. was awarded the 25-year State lease under which it has been working the property. The terms provided for a sliding scale of royalties, ranging from $0.63 to $1.53 per ton, dependent on the mining method used and on the dry content of the ore. At that time the tonnage remaining was estimated at 7,500,000. Of this the Charleson company has mined 3,056,000 in the three shipping seasons of 1943-45 inclusive. The tonnage extracted in the three years was 996,000, 1,209,000, and 851,000, respectively.

The Charleson company is an independent concern headed by E. F. Remer, of Hibbing. Charles H. Remer is vice-president and general superintendent. The Remers were the pioneers in using trucks in the Mesabi open-pit iron mines.

Exploration of the remaining ore was started by the new lease holders in the latter part of 1942. Meanwhile, plans were formulated for the truck and conveyor system. The mining equipment provided and in use today includes two 26-T churn drills and one 27-T Bucyrus-Erie churn drill; four shovels, including gas-driven and diesel-powered types ranging from 1¼ to 1½ cu. yd. in dipper capacity; one power grader; one D8 Caterpillar bulldozer; several 15-ton Euclid rear-dump trucks and four 8-ton tandem-drive Ford trucks. The latter are used primarily for removing rock and waste to stockpiles. Length of haul ranges from 1,000 ft. to 5,000 ft. on a maximum grade of 10 percent on the main haul road. In some parts of the mining area the grade is as high as 14 percent.

Mining is done in benches, the cuts averaging 12 to 20 ft. in height and 30 to 150 ft. in width. The trucks deliver to a 45-ton pocket, from which the ore is fed by a 48-in. by 12-ft. pan feeder to a sloping bar grizzly. Minus-6-in. material, the undersize, passes through chutes to a 30-in. belt-conveyor line. Oversize is crushed to 6 in. in a 48x36-in. Allis-Chalmers jaw crusher, driven by a 125-hp. motor through V-belts.

The original line used during the 1943 season consisted of only three flights. The first, starting on a plus-4-percent grade, passed through a 250-ft. radius vertical curve to a 19-deg. 5-min. slope. The second and third flights had an 18-deg. 30-min. slope. The first two flights were each powered by a 60-hp. gear motor, flight three being driven by a 125-hp. motor through a V-belt chain reduction.

Conveyor Facts

Distance, c. to c., ft.	946
Total lift, ft.	272
Grade, percent	35.53
Belt speed, wet or dry, ft. per min.	578
Capacity, 5-in. (aver.) iron ore, tons per hour	550

Single Lift Is Best

The two transfer points, having as much as 41 in. of drop, gave trouble when wet, painty ore was handled, the average tonnage per 24-hour day being 4,000 to 5,000. The cost of operating and maintaining these transfers was $6,000 to $10,000 per year. Plans called for increased produc-

THE 946-FT. BELT CONVEYOR, which lifts iron ore 272 ft. vertically to surface out of the Missabe Mountain mine. Looking up the vertical curve, as the belt passes through the bridge.

tion, and it was apparent that a better conveyor system was needed. Decision to install a single-lift system was finally reached.

A cotton-cord belt 30 in. wide made by the B. F. Goodrich Co. was selected. This was constructed with six plies of cord upon two base plies of heavy duck having a ¼-in. top cover including a Transcord breaker and a ⅛-in. bottom cover, all of GR-S synthetic rubber. The weight per foot of belt was 11 lb.

The grade had to be changed to accommodate this single-lift system. The most difficulty was had at the second transfer, which was at the halfway point of the 450-ft. 8x8-ft. timbered drift or tunnel through which the conveyor line had to pass. Here a slight vertical curve was put in. The vertical curve at the bottom was given a 500-ft. radius and has presented no trouble.

A 200-hp. slipring motor drives the belt through a double V-belt reduction ratio of 27:1. Through a flexible coupling connecting the motor shaft to an extension, upon which is mounted a 13-in.p.d., 18-groove, D-section pulley, with two differential hold-backs at each end of the shaft and two self-aligning ball-bearing pillow blocks mounted between the pulley and the hold-backs, power is transmitted by 18 D-300 V-belts to a 78-in.-diameter flat pulley. On each side of this pulley there is a heavy-duty self-aligning pillow block and a 20-groove D-section, 19-in. p.d. pulley. Forty D-360 V-belts transmit the power to two 84-in. diameter flat-faced pulleys mounted on the 7-in. diameter head shaft. As an added safety precaution, one of the 84-in. diameter pulleys has 3 in. of extra face provided for a differential-type hold-back mounting.

Pulley Face Improved

The pulley face has a standard crown, which is objectionable when operating belting under high stress. A herringbone type of lagging with the base so made as to eliminate the crown was applied. After two seasons this lagging showed little wear, whereas the previous rough-surface lagging had worn smooth in half a season. The wrap at the 48-in. diameter head pulley is 253 deg. and is obtained by the aid of a 36-in. diameter snub pulley. Since this herringbone lagging was adopted for the snub pulley, no maintenance has been required and no build-up of material of even the slightest amount has been experienced, such as previously had given trouble with the bare surface.

Length of the remodeled conveyor system is 946 ft. on pulley centers with a 272-ft. lift. The belt is loaded on approximately a plus-4-percent grade, passing thence through a vertical curve of 500-ft. radius to a tangent on a slope of 18 deg. 30 min. plus.

During a period of operation at a rate of 590 long tons per hour, 580 ft. per minute, the horsepower input into the belt was calculated to be 186 hp., allowing for a 95 percent drive efficiency. Effective tension is 10,600 lb. Belt slope tension, due to the 12.4 lb. per foot of belt weight, is 2,920 lb., the friction force of the moving parts, which amounts to 475 lb., having been deducted. Necessary

CONVEYOR LINE, a single belt, 946 ft. between centers, takes ore from loading point at bottom of pit, to railroad loading pocket on surface at edge of pit. During one period of operation, the belt required 186 hp. to transport 590 long tons per hour.

LOOKING SOUTHEAST along the Lone Jack trough in the Missabe Mountain pit. In this area there is still 2,500,000 tons of iron ore. New northeast wall road is seen under construction to provide a short haul. At right is the long-haul road from the east end.

lack-side tension, or theoretical slack-side tension, using a friction coefficient of 0.35 for rubber against rubber and a 253-deg. wrap, is 2,860 lb., or less than the slope tension. Maximum belt tension is 10,600 plus 2,920 plus 670, equal to 14,190 lb., or 73 lb. per inch of width, or 59.1 lb. per ply-inch working stress.

There is a counterweight of 2,290 lb. at the tail pulley, which gives 1,145 lb. tension per strand of belt. The idler retarding force theoretically amounts to 475 lb., which gives 670 lb. of effective counterweight tension.

Production Increased

After two seasons of actual operations of the single-lift conveyor system, it was found that production had increased to an average of 7,500 long tons per 24-hour day and at times as high as 10,000 tons per day. This high figure was attained at those times when the ore was dry and a small percentage had to be crushed.

From the conveyor the ore is dropped into a 150-ton pocket, from which it is loaded into 50- and 75-ton cars through two air-operated gates. Movement of the cars under the gates is controlled by air and the same operator.

Air is supplied by a 284-cu.ft. I. R. compressor to a large receiver, both of which are mounted in the pit, serving the shops and ramp. A 1½-in. line along the conveyor gallery feeds air into another large receiver at the loading pocket.

REACHING SURFACE. the conveyor delivers the ore to the pocket for loading railroad cars. Movement of cars is controlled by air.

Pumping is a large item of cost. Water is received normally at a rate of 3,000 g.p.m. Equipment consists of two 2,000-g.p.m. pumps and one 1,200-g.p.m. pump, with a booster pump for one of the 2,000-g.p.m. units and for the 1,200-g.p.m. pump. Average cost is $60,000 per year, which cost is proportioned between the City of Virginia, the owner of the pumping equipment, and the company. Water for public use is filtered and purified.

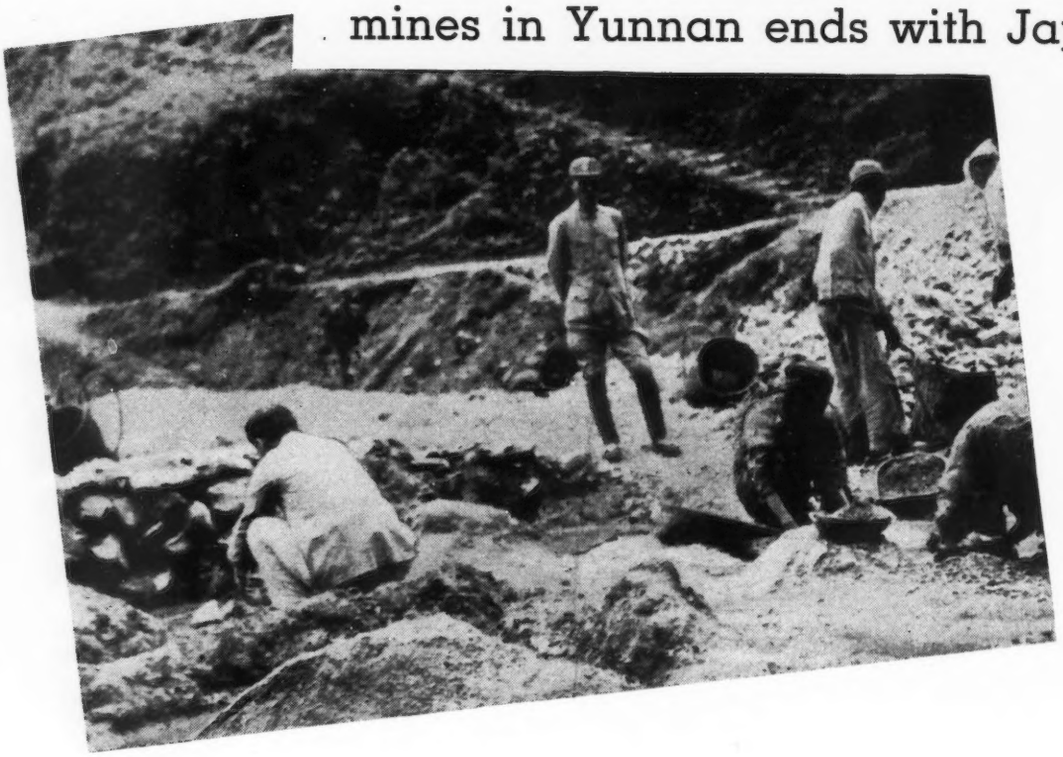
During the four to five winter non-shipping months, lean ores are stocked and rock is removed from cuts in preparation for next season's operations. Repairs are made on all equipment, trucks, shovels, and crusher. Conveyor-belt top-cover repairs are made at this time also, with provisions made for housing and heating of a building over the conveyor. A No. 10 double-platen Heintz vulcanizer is used in curing the repairs. The idle equipment is gone over to replace worn-out bearings and shells.

J. C. Henry, superintendent, has directed the successful operations at the Missabe Mountain mine for the past several seasons.

A Wartime Effort to Boost China's Metal Output

LIONEL E. BOOTH, Booth Engineers, Salt Lake City, Utah

Project for increasing production of copper from mines in Yunnan ends with Japan's surrender



AT TANG TAN MINE, which is said to have been yielding copper for 400 years, the entire area is covered with ancient dumps of slag and waste. Here coolies are seen panning copper concentrates from the latter.

IN APRIL 1945 I was asked to go to China by the Nelson Production Mission, being told that something had to be done to increase the production of non-ferrous metals there to reduce the tonnage of these materials that was being flown over the "Hump." Whatever was done to increase China's metal or mineral production, it was further explained, would have to be accomplished by extremely simple or makeshift methods, and with facilities, apparatus, and equipment that were available in China or that could be made there and of local material.

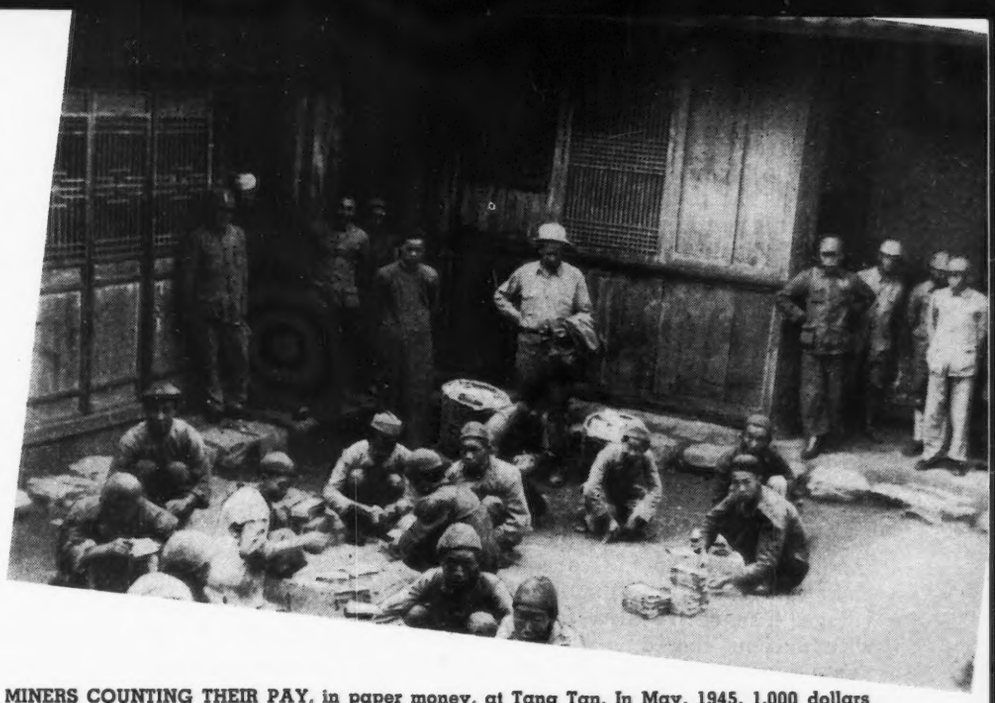
Among the items of ore-dressing and ore-preparation equipment that I thought might possibly have practical application under wartime conditions in China was the spiral concentrator. In Denver I found I. B. Humphreys enthusiastic about the practical aspects of using his spiral. He and his engineers gave me every possible assistance, including complete detail drawings of various arrangements of the spirals, with the necessary auxiliary equipment. Tests were made at their laboratory on different kinds of ore and the methods of making them were described. The pattern shop was visited, as was also the foundry, where some of the manufacturing details were explained. Mr. Humphreys also furnished an aluminum pattern of the spiral to facilitate manufacture in China and supplied enough of the small parts, such as water cutters and concentrate splitters, for a five-turn spiral. Pattern and parts weighed less than 20 lb. packed in a small suitcase.

I left Washington on May 3, by Air Transport Command, and reached my destination, Chungking, on May 12. Information on the spiral was shown to Chinese engineers representing the Chinese W.P.B. and National Resources Committee, with the result that T. K. Chang, director of the Department of Materials of the W.P.B., advised that orders would be placed immediately for manufacture and installation of a pilot plant using it, together with the necessary auxiliary apparatus. The equipment was to be made and set up at Kunming.

In Chungking, I met Major Sergei Lavrov and George P. Hulst, both members of the Nelson Production Mission (later called American Production Commission) in the nonferrous section. The three of us were associated in all the work that followed: Lavrov on mining, Hulst on smelting, and myself on ore dressing. Lavrov had the benefit of about ten years' experience in mining and engineering work in China, and this

proved invaluable in the work that was to follow. Hulst's smelting experience dated back to the 90's and early work at the Omaha smelter of the American Smelting & Refining Co. The three of us were to cooperate on increasing non-ferrous mineral and metal production, particularly copper, under wartime conditions.

Discussing possible equipment needs with the Chinese engineers, we learned that there was some idle equipment, including a jaw crusher, rolls, screens, and possibly other items, at the Sanshi Electro-Metallurgical Works, about 60 miles from Chungking. Accordingly, Major Lavrov and I, with two Chinese engineers, started off by car to see if we could utilize any of it in our work.



MINERS COUNTING THEIR PAY, in paper money, at Tang Tan. In May, 1945, 1,000 dollars in national currency was equivalent to one United States dollar. Hence the piles of bills on the ground and in baskets.

The Transport Problem

This first short trip gave me a slight insight into the unusual problems facing us. Leaving Chungking, the car was ferried across the Yangtze, and we continued downstream on a fairly good road. About 30 miles along the way, the car suddenly swerved and hit the embankment that fortunately was on that side of the road. One tire was ruined, the wheel bent so badly that going on was out of the question, and the steering mechanism was broken. Hailing a passing truck, we rode back to a small village, Ipang Chang, where we telephoned to Chungking for a car. A jeep arrived four hours later, and we went on, arriving at Sanshi that afternoon, after being ferried across another river. This ferry, a scow, was operated by coolies using a cable stretched across the stream. At Sanshi we found some idle equipment that might later be put to useful work, and we at least had learned something about the transportation problem. Returning to Chungking the next day, 14 trucks were counted along the way in various states of repair, almost any kind of a job being attempted on the roadside; some were in ditches and others apparently waiting for tires.

Spirals Ordered

Plans were finally completed for our survey of the copper, lead, and zinc mining areas in Yunnan, and Lavrov, Hulst, and I left Chungking for Kunming. During the next few days we visited local industrial plants. On May 23 arrangements were completed with the Central Machine Works for a 5-turn and a 3-turn spiral, complete with a small sand pump and other auxiliary apparatus so that a pilot plant could be set up at the Electro-Metallurgical Works, near Kunming.

These works were typical of a great part of industrial China under current conditions. The principal product was electrolytic copper, the plant having a maximum capacity of 3 tons per 24-hour day. A small reverberatory furnace was available for melting and casting blister copper and this same furnace was used for melting and casting the electrolytic metal. A small copper blast furnace and a still smaller cupola furnace for making cast iron were also available. Like many other plants, this factory had to make most of the products required for its operation, such as brick and chemicals. Soap and other household supplies were manufactured for the workers' use. Cryolite was produced for reduction of aluminum ores in a small semi-pilot plant. Wood and charcoal were the principal fuel. Clay and other materials for making brick were crushed and prepared in an old *arrastre* with water buffalo for motive power.

During the next few days we were busy preparing to go to the mines. We left Kunming for Tungchuan on May 26. The road was rough and steep in places and full of chuck holes at other points. The 158-mile trip took 13 hours. Along the route we gained more information about transportation and began to get the idea forcefully that "in China, not so simple."

Along the way were hundreds of coolies carrying their products to market, mostly on their backs, and we learned that it was not unusual for them to travel more than 200 miles on such a trip. A few pack trains were seen, some pony-drawn carts, and once in a while a water buffalo, harnessed to a cart; but for the most part, the loads were carried on the backs of sweating coolies.

At the Copper Mines

We left Tungchuan by horseback and with pack animals on May 29 for the copper mines of Tang Tan and Loshue. The two-day trip to Tang Tan was over narrow trails and through precipitous canyons. Several streams were forded—one, the Shiao Kiang, a tributary of the Yangtze, with the aid of river boys. In the 43 miles from Tungchuan to Tang Tan we had traveled over two mountain ranges of from 8,500 to 9,000 ft. elevation, and dropped down to rivers of less than 4,000 ft. elevation before arriving at Tang Tan, at about 5,500 ft. above sea level. This is situated in some of the most rugged and inaccessible terrain in China. The topography is subject to rapid erosion, for the country is practically denuded of timber or even small brush. Alluvial flows are common, and landslides sometimes obliterate whole villages. During the monsoon season transportation over the steep, narrow trails, in places less than a foot wide, becomes more hazardous. Several weeks are often required to effect shipment of blister copper from the mines to the refinery at Kunming, 210 miles by trail and road. An alluvial flow had dammed the Shiao Kiang about 1,300 ft. in elevation below the Tang

Tan mine, and the lake formed was to figure later in our plans for transport of equipment and material to and from the mines.

According to the Chinese, the Tang Tan mine has been yielding copper for 400 years. Earliest recorded production was in 1726, when the output was nearly 1,000 tons. The largest annual production was between 1773 and 1882, when 2,400 tons of blister was averaged yearly. Production from 1939 to 1944 averaged close to 106 tons annually. Total production, according to record, is more than 300,000 tons.

Tang Tan is on the brow of the mountain, and the native smelting plant is right in the middle of the village. The entire area is covered with ancient slag dumps and mine waste dumps. Numerous tunnels and inclined shafts dot the hillsides, the openings in some appearing so small as to be practically unworkable.

How the Ores Occur

The ore occurs in patches, band, and streaks in limestone and varies from a few millimeters to several centimeters in thickness. Much of the copper is in the form of oxidized minerals, malachite, azurite, and chrysocolla, but a reasonable amount of the sulphides, covellite, and bornite are present, with smaller amounts of chalcopyrite and chalcocite. The mountain sides, from a considerable area, seemed honeycombed with ancient workings. No maps were available, except for some of the more important tunnel levels; but it was evident that the ancients had stripped the best grade of ore for at least several hundred feet in depth.

All mining is done by hand, mine tunnels are low, crooked, and with uneven floors, and in some places it is almost impossible to worm your way through the openings. Native boys in stooped-over positions carried the ore in baskets hung from their buttocks. In this manner, they could crawl, when necessary, on hands and knees through the low, narrow, winding tunnels and drifts. The ore is delivered by coolie either to the smelter or to dumps for sorting or washing by hand. More than a hundred women and children were hand-sorting and washing low-grade ore and dump material.

It is estimated that there was at least 150,000 tons of dump ore and a substantial tonnage of old mine fills, ample to take care of our project. Samples were taken for testing at Kunming. The minus-½-in. dump material assayed 4.5 to 5.5 percent copper and the coarse material 1.5 percent. Ore being smelted ran about 10 percent copper and the mine fills were said to carry 4 to 5 percent copper.

HEAP ROASTING of the sorted ore, running about 10 percent copper, is practiced at Tang Tan, using wood as additional fuel. Here one of the roasting stalls is shown.

The Tang Tan property was operated largely on the leasing system, miners being paid for ore according to weight and copper content. No assaying was done, the whole transaction being made on a "look-see" basis, but the ore was weighed on a Chinese scale resembling our hay scales. During May the miner received 46,350 CN$ for a ton of 10 percent copper ore, 1,000 CN$ being equivalent at that time to about one United States dollar, so that the miner actually received the equivalent of more than 23c per pound for the copper.

Heap Roasting Used

The sorted ore, running about 10 percent copper, was roasted in heap-type roasters with wood as additional fuel. There were four native-type copper blast furnaces, each able to handle 2½ tons of ore per 24 hours. Only two were in operation, because of fuel shortage. The furnace blowers consisted of a hollow log arranged with plunger and flap valves and operated by four coolies pushing and pulling the plunger, the stroke being a step and a half for the men. Wood, charcoal, and coke had to be transported for miles on the backs of coolies.

In all there were 994 workers at Tang Tan, including five engineers, 19 office workers, 300 on transportation, 100 on hand-sorting, and 460 underground. Production of copper in 1944 was 126 tons, this condition being reflected in the general poverty of the inhabitants.

We left for the Loshue copper property June 3, covering the 25 miles on foot and horseback. Here there were fewer inhabitants and people were even poorer than at Tang Tan. Small children huddled around the slag discharge to keep warm.

Tang Tan's Reserves

As at Tang Tan, mining and smelting have been going on for 400 years, the total copper output being much more than at Tang Tan, possibly 450,000 tons. During 1939 to 1944 it averaged only 70 tons annually. Reserves have been estimated by Chinese engineers up to more than 1,000,000 tons of ore ranging from 4 to 8 percent copper. There was plenty of waste-dump ore running 3 to 4 percent copper, and old mine-fill assaying 4 to 5 percent, upwards of 100,000 tons, which was more than ample for our project. Samples were obtained for testing in the pilot plant at Kunming.

The Loshue Mine

Mining and smelting were done at Loshue in much the same way as at Tang Tan, although mostly for the account of the mining company. Mining was all by hand. Power equipment had been used to some extent, and there was an Ingersoll-Rand Type 40, 2-stage air-cooled compressor with a Waukesha Hesselman 4-cylinder oil engine, and a number of jackhammers and stopers. None of this equipment was in use, because of lack of fuel.

The smelter could turn out nearly 2 tons of crude copper per day but was running less than half time because of shutdowns for repairs, and lack of fuel and ore. The furnace was of native construction but had

Electric power was generated by a hydroelectric plant 3 km. away.

The orebody was more regular here than at Tang Tan. With proper development the mine could be an important source of copper to meet China's postwar needs. The copper minerals, principally bornite and chalcocite, though occurring in massive form to some extent, were largely disseminated throughout the gangue rock of siliceous and dolomitic limestone, in hair-like streamers, earning the local name of "horse-tail" ore.

Smelter feed averaged 10 percent copper, mined ore being sorted to give this grade. The supply was augmented by hand-breaking and sorting old dump material. In addition, a native washing plant furnished a small amount of high-grade concentrates. This was modeled after the native tin concentrators where the fine sands were panned in bamboo pans and the slime is washed and concentrated by flicking water with a bamboo stick to thickened slime piled on a gently sloping sluice.

Here the force totaled 393, including 120 workers underground, 95 hand-sorters, and 60 smelter workers. Conditions at the village were decidedly unsanitary.

Water power was abundant. Chinese engineers had assembled data on various locations where hydroelectric power could be developed. Sites were available for producing 60 to 15,000 hp. We made a cursory examination and obtained detailed information on a site sufficient for developing 200 kva. for our project.

We left Loshue to return to Tungchuan on June 6, and after fording the Shiao Kiang found that the village almost completely engulfed with a mud and gravel flow. This had come down a canyon that we had traveled on the incoming trip and was typical of the terrific erosion of the terrain in this area. The flow was at least a mile wide, six miles long, and 15 ft. deep at the center. We had to skirt the edge of the flow along the canyon sides for a considerable distance, the edges being like quicksand. Two of the pack horses tried walking across the edge of the flow but were up to their necks in sand in a moment.

Lead and Zinc

Several days were spent again at Tungchuan, and then we set off to examine lead and zinc mines in the Kwangshan Cheong district. This two-day trip was a repetition of the other journeys, but the traveling was less difficult.

The deposits here have been worked for 400 years, originally for silver and later for lead and zinc. Ores mined have been almost completely oxidized. The zinc orebody contains relatively little lead and the lead ore only small amounts of zinc.

According to Dr. Singwu C. Hsu, the chief source of lead is in the crystalline Uralian limestone in the southeastern limb of the Kwangshan anticline. The bedded deposit dips southeast at 25 to 32 deg. It extends horizontally about 1½ km. along the strike and downward to about 200 meters depth. At present, only one layer of bedded lead ore is known in Kwangshan. It extends about 2 km. and downward from 50 meters below the surface to about 200 meters. The chief minerals are minium. Galena occurs at depth as residual primary sulphide. The gangue minerals are dolomitic limestone, calcite, limonite, and quartz. Locally, the ore is known as "yellow flour ore" because of its color and fine subdivision. It averages 17 percent lead. Nearly two-thirds of the deposit has been mined.

Screen tests on waste lead ore, at Kunming, later showed that 75 percent of the ore, as mined, would pass a 200-mesh screen, the undersize representing 61 percent of the total lead.

Again, according to the same authority, the axial portion of the Kwangshan anticline is featured by a string of elongated depressions. This belt, with limestone as its floor, is crowded with tensile and shear joints. As the two kinds of joints differ in trend, they often intersect and are subsequently enlarged by the solution of circulating water and extend to great depth. At the intersections there is usually a pocket. The ore minerals are all secondary, derived from the primary sulphides through carbonization and, less prominently, silicification in the zone of oxidation. The principal zinc minerals are smithsonite, calamine, hydrozincite, and zincite, with barite, calcite, dolomite, and secondary quartz as the gangue minerals. The deposits are irregular, widening and narrowing at intervals, but usually extending to some depth along the joints. The deepest mine being worked has already reached about 80 meters' depth, the deposit appearing to continue downwards along the vertical joints. Old pits indicate that the top of the deposit was exposed on surface, the depth to which the orebody has extended thus appearing to be more than 100 meters.

BLACK COPPER in cakes is seen here at Loshue stacked ready for shipment. Smelter feed averaged 10 percent in metal, the mine ore being hand-sorted to give this grade.

Methods at Kwangshan

Ancient methods of hand mining and smelting were still in use at Kwangshan. The shaft at the zinc mine was a zigzag affair, completely timbered with 3- to 4-in. lagging. There was just enough moisture and mud to make travel hazardous, especially if one wore shoes; the natives, wearing grass sandals or going barefoot, got along better.

Ore selected in mining or by hand sorting was smelted. Lead ore for the blast furnace averaged 22.5 percent lead. The average grade of the zinc ore was 36.5 percent zinc. Smelting was handicapped by the transportation, fuel, and power problem.

Typical 24-hr. Charge and Yield, Native Zinc Smelter

	54 Retorts	36 Retorts
Zinc ore, average grade 36 percent Zn	400 kg.	270 kg.
Anthracite or coke for reduction	100 kg.	70 kg.
Anthracite for heating	350 kg.	230 kg.
Zinc scrap reclamation	65 kg.	49 kg.
Clay for briquetting anthracite	195 kg.	150 kg.
Coal ash for briquetting anthracite	120 kg.	90 kg.
Water for briquetting anthracite	80 kg.	50 kg.
Crude zinc produced in 24 hours	30 kg.	20 kg.
Retort residue available for reclamation	255 kg.	186 kg.

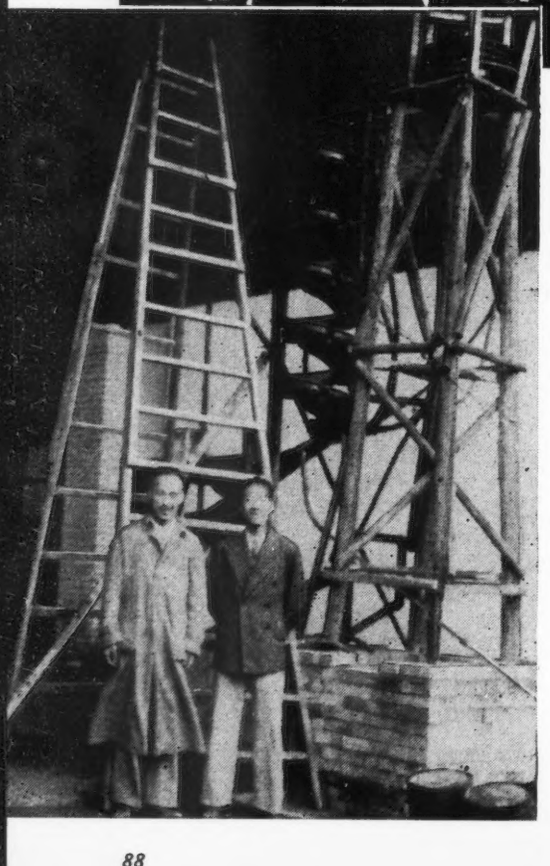
In all, 459 men were used in transportation, mostly to carry fuel for smelting.

The native lead furnaces, of which ten were in operation, were even smaller than those used for copper reduction. Each could produce about 220 lb. of lead in 24 hours. The same type of hollow-log blower was in use as that already described for the copper furnaces, though smaller, and was operated by women. The latter practically lived and raised their children right in the smelter. A typical 24-hour charge for the lead furnace was: Lead ore, average grade 22.5 percent Pb, 1,200 kg.; rich slag, 2 to 6 percent Pb, 350 kg.; coke, 150 kg.; semi-bituminous coal, 50 kg.; and calcined semi-bituminous coal, 450 kg.

Crude lead thus produced in 24 hours was 100 kg., a direct recovery of 34 percent.

Production cost in May 1945 was estimated at 350 CN$ per pound, or $0.35 U. S., at the then existing black-market rate of exchange. To this should be added the cost of transporting the lead to market. In the first five months of 1945, a total of 46 tons of lead was produced.

In the native zinc-distillation plant there were two banks of 54 retorts and two of 36 retorts. The retorts were 28.5 in. long and 4 in. in diameter. A typical record of native smelting practice is given.



韓福瑞螺旋選鑛機

These characters spell out the Chinese equivalent of "Humphreys spiral concentrator." Mr. K. C. Li, chairman of the Wah Chang Trading Corporation, New York, has kindly converted them into English as follows: Beginning at the left, characters 1, 2, and 3 mean "Humphreys." The remaining five mean respectively, "spiral," "revolving," "selecting," "ore," "machinery."

A SPIRAL CONCENTRATOR set up for pilot-plant test work. The two men are W. C. Chang and T. Y. Chu.

Various samples of lead and zinc ores and dump material were collected for testing at Kunming, and we returned to Tungchuan. The monsoon rains were on in earnest, and we were unable to leave here for several days, but were finally on our way to Kunming on June 19.

The Spirals Ready

During our absence, the spirals had been constructed and set up in the shops of the Central Machine Works. After a preliminary test run, the equipment was installed at the copper electrolytic refinery on the Burma road, 10 miles from Kunming.

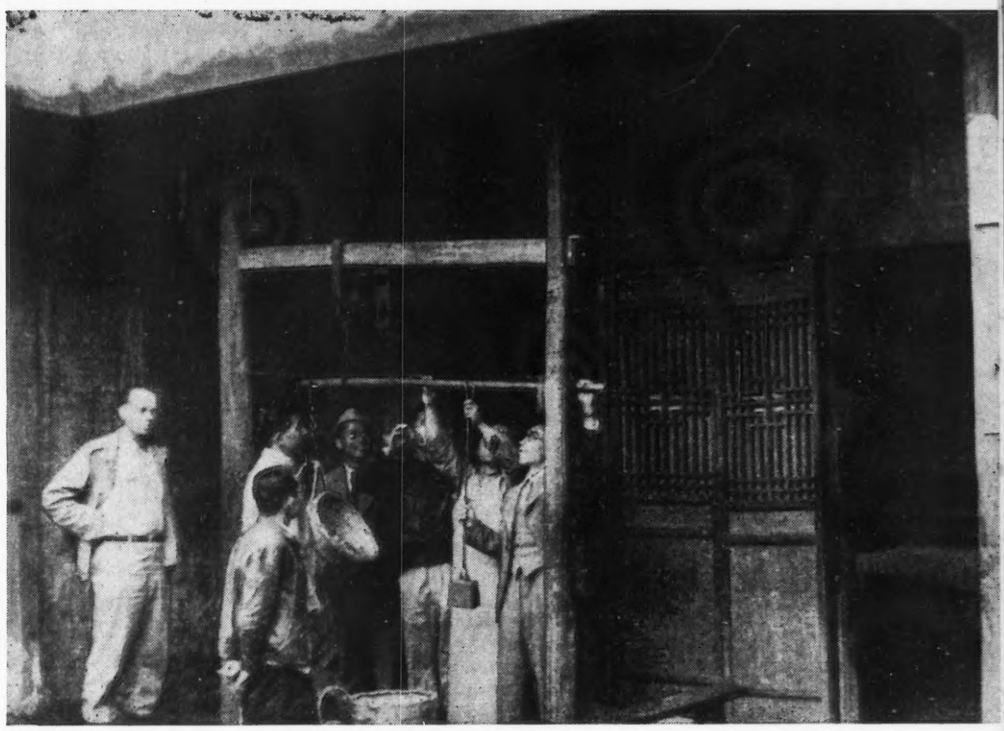
For the next 45 days we were busy testing the copper, lead, and zinc ores on the spirals, and locating equipment and assembling data, all in relation to building small plants for treating the copper ores. For preparing the ores for testing, we used a small jaw crusher that reduced the ore to minus ½ in. From this point on, all ore for treatment in the spirals was crushed to minus 14 or 20 mesh by hand.

Pilot-plant test work indicated it would be impractical, even under wartime conditions, to treat the lead and zinc ores with the spirals. Results obtained with them in testing the Loshue and Tang Tan ores, however, indicated that there was a simple means of possibly tripling the copper production of China. Two Roots blowers, a No. 4 and a No. 5, were available at Tungchuan, so in treating these two copper ores, provision was made for floating the minus-20-mesh spiral tailings in free-air-type flotation cells. Flotation tests were then made, utilizing reagents available locally. Results are tabulated.

The zinc retort operation indicated a recovery of approximately 21 percent. Production costs during May 1945 were approximately $0.37

Results Obtained in Concentrating Two Copper Ores With Spirals and Flotation

Loshue Waste Ore	% Wt.	% Cu	% Total Copper
Spiral and flotation concentrates	14.8	24.7	84.0
Final tailing	85.2	0.82	16.0
Heads	100.0	4.35	100.0
Tang Tan Waste and Mine Fill Ore	**% Wt.**	**% Cu**	**% Total Copper**
Spiral and flotation concentrates	18.4	23.7	80.1
Final tailing	81.6	1.33	19.9
Heads	100.0	5.45	100.0



A LEASING SYSTEM is employed largely at Tang Tan, the miners being paid for ore produced according to weight, as determined by the Chinese scale shown here, and the copper content ascertained on a "look-see" basis.

U. S., per pound, using the same basis of exchange as for the lead cost figures. Not all of the ore produced at Kwangshan was retorted here. Most of the zinc ore was transported by coolies to Heitso Kiang, about 15 miles away on a tributary of the Yangtze. Here there were 12 banks of 54 retorts. The smelter produced was transported down river to Chungking.

A good part of the copper mineral, principally bornite, in the Loshue ore was disseminated in hair-like streamers throughout the gangue. Crushing to 20 mesh failed to liberate it completely.

The Tang Tan ore did not exhibit the fine dissemination of copper minerals but had a relatively large proportion of oxidized copper to account for the high tailing loss.

Results Promising

The pilot-plant work indicated that more than 2 tons of copper per day could be produced from Loshue ore in a plant able to handle 60 tons of waste ore per day with the spirals followed by simple flotation of the minus-20-mesh tailing. Loshue had produced 86 tons of copper in 1944, so a good increase could easily be made from the simple milling of waste ore. Practically the same conditions were true of Tang Tan, and the copper production possible from both sources could more than triple China's wartime copper production. It seemed a small amount of copper, but such a production would have met China's immediate requirements and eliminated the tonnage being brought in by air.

At the time the test work was being done, other phases of the problem were investigated. These involved equipment requirements, power, transportation, fuel, and labor problems. Jaw crushers, 9x15-in. in size, were being made in China, and we had the detailed design for crushing rolls of 12-in. (face) x 24-in (diameter); also the designs for 2-in. and 3-in. sand pumps. In fact, all of the equipment needed for the actual ore treatment was available or could be made in China. A two-deck mechanical vibrating screen was available at Sanshi, near Chungking; some 10-mesh screen was found which would have been satisfactory for initial use, pending the arrival of screen cloth with 20-mesh opening.

Our initial recommendations were for a 60-ton plant at the Loshue copper property, because of the ready supply of ore and proximity of available water power. A hydroelectric plant was to be installed on a stream, 3 km. from the mine. A synchronous motor was available at the Central Machine Works, and this was to be utilized as a 200-kva. generator, to be installed at the power site together with a direct-connected exciter and a Pelton wheel to be constructed by Central Machine Works. All necessary motors, switch gear, controls, and wire were located, sufficient for our requirements and also to supply enough power to operate the Ingersoll-Rand Type 40 compressor for mining.

The smelting equipment was to operate in its then-existing condition, but plans were made to install a water-jacketed furnace and improve roasting equipment as quickly as possible.

Transportation Slow

The problem of transporting the equipment and the fuel for smelting to the property and of taking the finished copper away was serious. Some of the equipment needed would require months to transport it to the mine if the existing methods of hauling were used. This phase of the problem was receiving attention from Major Lavrov, and his plans called for use of air transport if at all feasible. The Army and Navy were interested and investigated the matter of transport. We were more than pleased to be informed that it would be feasible to carry our equipment to the lake near Tang Tan and the finished copper from the lake to Kunming.

War Ends, Plans Abandoned

By this time we had assembled all equipment required for the initial spiral project at Loshue and were ready to present facts and figures to the Chinese War Production Board at Chungking. On Aug. 10 we received our first authentic information that Japan was ready to surrender. If this were true, it would necessarily alter our recommendation, as the project we were proposing was solely to meet a wartime condition, and with Chinese ports open for shipping, it would have to be changed. After several days' consideration in Chungking it was decided to abandon the plans made to meet the wartime copper requirements and to reconsider the copper development under more normal conditions.

Thus ended our copper project, which would have tripled China's copper production in a matter of a few months. At present the plans developed for copper production at Loshue are being studied carefully, and it is believed that a completely integrated copper project of substantial tonnage will result.

MARKET SUMMARY

PRESIDENT TRUMAN VETOED the OPA bill on June 29 and the House upheld his action, thereby ending price control. Paul Porter, OPA Administrator, predicted that Congress would soon approve legislation reviving price control and urged that producers and sellers "act with restraint." With the Premium Payment Plan, as well as subsidies involving purchase and sale of foreign metals, involved in the future of the program, the first few days of July found both buyers and sellers doing nothing to upset the markets, pending further developments.

Higher maximum prices for copper and lead became effective on June 3. Price action on zinc was deferred, pending further study of what is regarded as a complex problem. OPA removed ceiling prices on June 12 from chrome ore, cobalt, molybdenum, tungsten, and vanadium. Ceiling prices on Lake Superior iron ore were raised 50c. per ton on June 24. Higher prices obtaining in the "outside" market for refined platinum forced refiners to raise the price to $67 per ounce troy, wholesale lots, effective June 27. Antimony was strong and a higher price appeared to be imminent.

Demand for major non-ferrous metals was active throughout June. Owing in part to strikes, which were not settled in time to lift production, many consumers, even under voluntary rationing, secured only a fraction of the tonnages of copper and lead required to maintain normal manufacturing operations. However, producers were confident that some improvement in the supply situation would take place during July. The shortage in wirebars and cakes was particularly embarrassing to consumers.

Excepting a strike at mines of the New Jersey Zinc Co., all major labor disputes in the non-ferrous metals industry of this country were settled before the end of June.

Production of refined copper in the United States in May amounted to only 20,551 tons, which contrasts with a monthly average of 70,259 tons for 1945. Deliveries were maintained at a fairly high level, totaling 93,647 tons, of which 83,402 tons were supplied by the Office of Metals Reserve. The Government's stockpile of copper has been reduced sharply this year, and is expected to drop to less than 275,000 tons by July 1. Authorities in Washington admitted that large importations of copper will be necessary in the second half of the year to maintain adequate reserves, yet no purchases were made in June. How-

Major Metals

U. S. DAILY AND AVERAGE PRICES

1946 May	Electrolytic Copper: Domestic (a) Refinery	Electrolytic Copper: Export (b) Refinery	Straits Tin: New York	Lead: New York	Lead: St. Louis	Zinc: St. Louis
June						
1	11.775	14.225	52.000	6.50	6.35	8.25
3	14.150	14.250	52.000	8.25	8.10	8.25
4	14.150	14.325	52.000	8.25	8.10	8.25
5	14.150	14.325	52.000	8.25	8.10	8.25
6	14.150	14.500	52.000	8.25	8.10	8.25
7	14.150	14.425	52.000	8.25	8.10	8.25
8	14.150	14.375	52.000	8.25	8.10	8.25
10	14.150	14.375	52.000	8.25	8.10	8.25
11	14.150	14.425	52.000	8.25	8.10	8.25
12	14.150	14.375	52.000	8.25	8.10	8.25
13	14.150	14.400	52.000	8.25	8.10	8.25
14	14.150	14.425	52.000	8.25	8.10	8.25
15	14.150	14.425	52.000	8.25	8.10	8.25
17	14.150	14.500	52.000	8.25	8.10	8.25
18	14.150	14.425	52.000	8.25	8.10	8.25
19	14.150	14.425	52.000	8.25	8.10	8.25
20	14.150	14.425	52.000	8.25	8.10	8.25
21	14.150	14.500	52.000	8.25	8.10	8.25
22	14.150	14.500	52.000	8.25	8.10	8.25
24	14.150	14.375	52.000	8.25	8.10	8.25
25	14.150	14.550	52.000	8.25	8.10	8.25
26	14.150	14.550	52.000	8.25	8.10	8.25
27	14.150	14.550	52.000	8.25	8.10	8.25
28	14.150	14.550	52.000	8.25	8.10	8.25
29	14.150	14.550	52.000	8.25	8.10	8.25
AVERAGES FOR MONTH						
June	14.055		52.000	8.180	8.030	8.250
AVERAGES FOR WEEK						
5	13.200	14.254	52.000	7.55	7.40	8.25
12	14.150	14.413	52.000	8.25	8.10	8.25
19	14.150	14.433	52.000	8.25	8.10	8.25
26	14.150	14.483	52.000	8.25	8.10	8.25
CALENDAR WEEK AVERAGES						
June						
1	11.775	14.204	52.000	6.50	6.35	8.25
8	14.150	14.367	52.000	8.25	8.10	8.25
15	14.150	14.404	52.000	8.25	8.10	8.25
22	14.150	14.463	52.000	8.25	8.10	8.25
29	14.150	14.521	52.000	8.25	8.10	8.25

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

Effective March 14, our export quotation for copper reflects prices obtaining in the open market and is based on sales in the foreign market reduced to the f.o.b. refinery equivalent, Atlantic seaboard. On f.a.s. transactions we deduct 0.075c. for lighterage, etc., to arrive at the f.o.b. refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than 1c. over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Silver, Gold and Sterling

DAILY AND AVERAGE PRICES

1946 June	Sterling Exchange: "Checks" (e)	Silver (c): New York (e)	Silver (c): London (e)	Gold: London (e)	Gold (d): United States
1	(e)	(e)	(e)	(e)	$35.000
3	403.000	70.750	44d.	172s. 3d.	35.000
4	403.000	70.750	44d.	172s. 3d.	35.000
5	403.000	70.750	44d.	172s. 3d.	35.000
6	403.000	70.750	44d.	172s. 3d.	35.000
7	403.000	70.750	44d.	172s. 3d.	35.000
8	(e)	(e)	(e)	(e)	35.000
10	403.000	70.750	44d.	172s. 3d.	35.000
11	403.000	70.750	44d.	172s. 3d.	35.000
12	403.000	70.750	44d.	172s. 3d.	35.000
13	403.000	70.750	44d.	172s. 3d.	35.000
14	403.000	70.750	44d.	172s. 3d.	35.000
15	(e)	(e)	(e)	(e)	35.000
17	403.000	70.750	44d.	172s. 3d.	35.000
18	403.000	70.750	44d.	172s. 3d.	35.000
19	403.000	70.750	44d.	172s. 3d.	35.000
20	403.000	70.750	44d.	172s. 3d.	35.000
21	403.000	70.750	44d.	172s. 3d.	35.000
22	(e)	(e)	(e)	(e)	35.000
24	403.000	70.750	44d.	172s. 3d.	35.000
25	403.000	70.750	44d.	172s. 3d.	35.000
26	403.000	70.750	44d.	172s. 3d.	35.000
27	403.000	70.750	44d.	172s. 3d.	35.000
28	403.000	70.750	44d.	172s. 3d.	35.000
29	(e)	(e)	(e)	(e)	35.000
AVERAGES FOR MONTH					
June	403.000	70.750	44d.	—	35.000
AVERAGES FOR WEEK					
5	403.000	70.750	—	—	—
12	403.000	70.750	—	—	—
19	403.000	70.750	—	—	—
26	403.000	70.750	—	—	—

Calendar week averages, New York Silver: June 1st, 70.750; 8th, 70.750; 15th, 70.750; 22nd, 70.750; 29th, 70.750.

(e) Not quoted (Saturday).

Quotations for lead reflect prices obtained for common lead.

(c) Silver other than newly-mined domestic, by Handy & Harman. Under Treasury order of July 6, 1939, the price on domestic newly-mined silver mined subsequent to July 1, 1939, was fixed at 71.11c. per troy ounce. Handy & Harman's quotation on newly-mined domestic silver 999 fine was 70⅝c. throughout June.

London silver in pence per troy ounce.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which is equal to $34.9125.

ever, negotiations to obtain foreign copper were in progress. New contracts could not be signed until necessary legislation for subsidy payments was passed by Congress. A tentative program for purchasing foreign copper involves 180,000 tons, according to reports in the trade.

Copper in the foreign market continued to rise under steady buying and smaller offerings. A strike at Chile Copper, threatening labor difficulties in Northern Rhodesia, and a power shortage at Katanga, were factors in the market. The world price, as determined by E.&M.J., advanced during June from 14.300c. a pound, f.a.s. Atlantic ports, to 14.625c.

Lead supply remained extremely tight, owing to strikes and reduced imports. Demand for lead, even under the limitations imposed by CPA, was sufficient to absorb 70,000 tons a month. Consumers obtained only 30,000 tons in June and they may not get much more than 40,000 tons in July. The price prevailing abroad advanced to around 9c. a pound.

Miscellaneous Metals Monthly Averages

Average prices of miscellaneous metals for May and June:

(a) New York, packed in cases, in lots of 5 tons or more but less than a carload. (b) Nominal. (c) Producer's price for commercial sticks. (d) Average producers' and platers' quotations. (e) Special shapes sold to platers.

	May	June
Quicksilver, N Y. flask	101.000	99.400
Antimony (a)	15.839	15.839
Antimony, bulk, Laredo	14.500	14.500
Antimony, bulk, N. Y.	15.265	15.265
Antimony, Chinese (b)	16.500	16.500
Platinum, oz. troy	52.769	53.000
Cadmium (c)	90.000	90.000
Cadmium (d)	92.500	92.500
Cadmium (e)	95.000	95.000
Aluminum ingot	15.000	15.000

E & M J Price Index

Weighted index of non-ferrous metal prices (copper, lead, zinc, tin, silver, nickel, and aluminum). The average for the years 1922-1923-1924 equals 100.

1929	110.33	1937	90.86
1930	82.87	1938	73.67
1931	60.20	1939	77.71
1932	48.26	1940	79.22
1933	59.79	1941	83.49
1934	65.59	1942	86.80
1935	74.66	1943	88.74
1936	73.45	1944	88.74
		1945	90.86

	1944	1945	1946
January	88.74	88.74	96.42
February	88.74	88.74	96.42
March	88.74	88.74	96.42
April	88.74	88.74	96.42
May	88.74	88.74	96.42
June	88.74	88.74	107.16
July	88.74	88.74	....
August	88.74	88.74	....
September	88.74	91.16	....
October	88.74	96.40	....
November	88.74	96.42	....
December	88.74	96.42	....

Miscellaneous Metals, Ores, Minerals

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

MISCELLANEOUS METALS

(July 1, 1946)

Aluminum, ingot, 99 plus per cent, lb.	15c.
Antimony, domestic, spot, lb., 5 tons or more	15.839c.
Bismuth, ton lots, lb.	$1.25
Cadmium, commercial sticks, lb.	90c.
Calcium, lb., ton lots, 97 @ 98 per cent, cast	$1.85
Chromium, 97 per cent grade, lb.	89c.
Cobalt, 97 to 99 per cent, per lb.	$1.50
Indium, troy oz.	$2.25
Nickel, electrolytic cathodes, lb.	35c.
Magnesium, 99.8 per cent, carloads, lb.	20½c.
Palladium, troy oz.	$24.00
Platinum (Official quotation wholesale lots) troy oz.	$67.00
Quicksilver, flask of 76 lb., 25 flasks or more	$99.00
Selenium, 99.5 per cent, lb.	$1.75
Silicon, minimum 97 per cent, spot, carloads, lb.	14.75c.
Tellurium, lb.	$1.75 nom.
Thallium, 100 lb. or more, lb.	$12.50 nom.
Titanium, 96 to 98 per cent, lb.	$5.00

METALLIC ORES

Beryllium Ore, 8 to 12% BeO, f.o.b. mine, per unit	$8.00@$10.00
Chrome Ore, per long ton, f.o.b. cars Atl. ports, dry 48% Cr_2O_3, 2.8 to 1 ratio (Prices nominal)	$41.00
48% Cr_2O_3 3 to 1 ratio	$43.50
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range Bessemer	$5.45
Mesabi bessemer	$5.20
Old Range non-bessemer	$5.30
Mesabi, non-bessemer	$5.05
Lead (Galena) 80 per cent, Joplin, Mo., ton	$99.96
Manganese, Metals Reserve Co. sales price, per long-ton unit of Mn contained, 48 per cent, subject to premiums and penalties, effective May 15, 1944: 85c. (duty paid) New York, Philadelphia, Baltimore, Norfolk, Mobile, and New Orleans; 91c., Fontana, Calif., Provo, Utah, and Pueblo, Colo. (Current prices in open market nominal at 73@75c. per long-ton unit.)	
Molybdenum Ore, 90%, per lb. of MoS_2 f.o.b. mines	45c.
Tungsten Ore, per unit of WO_3:	
Chinese, 60 per cent, duty paid	$24.00
Domestic, scheelite, 60 per cent and upward	$24.00
Vanadium Ore, per lb. of contained V_2O_5 f.o.b. mines	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton.	$50.00

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb., in bbl., carload lots	4c.
Cobalt Oxide, 70 @ 71 per cent, lb.	$1.06
Copper Sulphate, 100 lb.	$5.65

ALLOYS

Beryllium Copper, 2.5 to 3 per cent Be, per lb. of contained Be	$15.00
Ferrochrome, 65 @ 70 per cent per lb. of Cr contained	13c.
Ferromanganese, 78 @ 82 per cent, gross ton	$135.00
Ferromolybdenum, 55 @ 65 per cent Mo, lb. of Mo contained	95c.
Ferrosilicon, 50 per cent, per lb. of contained Si	6.60@8.10c.
Ferrotungsten, 75 @ 80 per cent, lb. of W contained	$1.90
Ferrovanadium, per lb. of V delivered	$2.70@$2.90
Silicomanganese, 1 per cent C, gross ton	$138.00

NON-METALLIC MINERALS

Asbestos, f.o.b. Canadian (Quebec) mines (U. S. funds), ton:	
Crude No. 1	$650@$758
Crude No. 2	$165@$385
Spinning fibers	$124@$233
Paper stock	$44@$49.50
Shorts	$14.50@$26.50
Vermont, f.o.b. Hyde Park:	
Shingle stock	$62.50@$65.00
Paper stock	$44.00@$53.00
Shorts	$14.50@$28.50
Floats	$19.50
Barytes, f.o.b. mines:	
Georgia, crude, per long ton	$8.50@$9.00
Missouri, 93 to 94 per cent $BaSO_4$, per short ton	$8.25@$8.50
Bauxite, long ton:	
Domestic, crude, 50 @ 52 per cent (not dried)	$5.00
Domestic, chemical, 55 @ 58 per cent	$7.50@$8.50
Domestic, abrasive, 80 @ 84 per cent	$16.50
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, No. 1, bulk	$6.75@$8.00
Delaware, No. 1	$15.00
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 60 per cent, all rail movement, ton	$30.00
Acid 98 and 1 per cent, bulk, ton	$37.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton dead-burned, f.o.b. Washington	$22.00
Mica: Domestic producers quote on punch and sheet as follows: Punch, 22c. per pound; 1½x2 inch, $1:10; 2x2 inch, $1.60 2x3 inch, $2.10; 3x3 inch, $2.75; 3x4 inch, $3.50; 3x5 inch, $4; 4x6 inch, $5. Wet ground, very fine, $90 per ton. Special grades command premium. Bulk sales dry ground, $32.50 per ton; Scrap, $28 per ton and up.	
Ocher, Georgia, ton	$19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c i f. Atlantic ports	12c. nom.
Silica, in bags, 325 mesh, ton	$20.00@$40.00
Sulphur, Texas, mines, long ton	$16.00
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
Vermont, extra white, 200 mesh	$9.50@$10.50
Tripoli, Missouri, ton:	
40 mesh, cream colored	$14.50

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton: Basic	$26.00
Steel, base price, Pittsburgh Billets, gross ton	$39.00
Structural shapes, 100 lb.	$2.35

WASHINGTON REFLECTIONS

McGRAW-HILL WASHINGTON NEWS BUREAU

House and Senate Agree On Stockpiling Measure

The military has won the last round in the fight for control of the board administering postwar stockpiles of strategic materials. A conference committee returned the bill to the House late last month.

The stockpile bill, designed to preclude the possibility of a shortage of critical materials in the event of another war, had been the subject of considerable controversy over who would run the governing board, civilians appointed by the President or the military. When the bill was first introduced in the Senate last fall, control was left up to a board dominated by a civilian to be appointed by the President.

Rewriting the Senate bill, the House vested control in the hands of the military and added an appropriation limit totaling $1 billion 800 million, to be spent in $360 million installments during a five-year period. Conferees allowed the House control measure to stand, and, as the bill now reads, stockpiles will be managed by a board consisting of the secretaries of War, Navy, and Interior, with the technical assistance of the Army and Navy Munitions Board. Assisting the board will be the secretaries of State, Treasury, Agriculture and Commerce, and industrial advisory committees appointed by the military. Money matters were eliminated from the bill, however, leaving appropriations up to Congress as funds are needed.

"Buy American" provisions, contained in the original 1939 act establishing wartime stockpiles, are retained in the new bill. The Treasury procurement division will make the necessary purchases "as far as it is practicable, from supplies in excess of industrial demand." This program is intended to provide for orderly acquisition of materials at reasonable cost and with minimum interference in the normal operations of producers and consumers.

One clause of the bill provides for the release of surplus Government stocks to industry "to the extent required to meet current deficiencies in supply." During the present period of shortages of critical metals, this practice of making surpluses available to industry has been carried on by CPA to a considerable extent. Several of the postwar stockpiles have been frozen by CPA to allow industry to obtain surplus materials.

Congress retains control of the disposal of materials which are no longer needed by the military. A full report must be sent to the Military Affairs committees of both houses of any proposed disposition, and, except where a revised determination is based on obsolescence, no stockpile materials may be disposed of without the approval of Congress. No such provision was contained in the 1939 act.

The House Military Affairs Committee, in its report on the bill, pointed out that "the existence of discretionary authority to release stockpile materials —except for war purposes, for rotation to prevent deterioration, or by reason of obsolescence—would present a grave threat to the stability of mining operations and the confidence necessary to maintain a sound and healthy domestic mining industry. It would thus imperil our major sources of many of these materials. The provisions under which Congress retains the key to the stockpiles are designed to minimize this threat."

Reports to Congress every six months are to be made by the secretaries of War and Navy, detailing the stockpiling activities, including information on foreign and domestic purchases.

Krug Calls for Inventory Of Our Mineral Resources

The lavish expenditures of American resources of minerals during the war have left the country a problem far more complex than gearing the economy for war, J. A. Krug, Secretary of the Interior, said recently at the commencement address at the Montana School of Mines.

"It may be trite but nevertheless a truism that our mineral resources are not inexhaustible. Their rapid depletion liquidates the very basis upon which this country's industrial and military might rests," Mr. Krug said, adding that the problem of depletion is of particular concern to mining engineers.

"Out of the long list of materials that we must have in order to hold our high place among the nations, there are only nine that are plentiful enough in our known domestic reserves to last through the 20th century at a normal rate of use," the Secretary said. These nine materials are iron, nitrogen, magnesium, salt, bituminous coal and lignite, phosphate rock, molybdenum, anthracite, and potash.

Reminding the new engineer before him that "the possession of a particular metal in great quantity does not guarantee that we can have all of the products that can be made of that metal as long as it lasts," the Secretary stated that the alloys for the metals are also important, and that this country now has only a two-year known supply of usable manganese, a seven-year proved supply of vanadium, and a four-year proved supply of tungsten.

All but minor percentages of a number of our most common and essential subsidiary metals have been mined from proved commercial reserves. The Secretary estimated the proved reserves of commercial grade ore, based on prewar normal consumption, to be able to supply our national total requirements less than 3 years for mercury, 4 years for platinum and antimony, 11 years for silver, 12 years for lead, 16 years for cadmium and 19 years for zinc. The highest-grade iron ore would be exhausted in about 22 years at normal rate of use, he said.

"We must have at the earliest possible time a complete and accurate inventory of our national resources and of our technology in relation to those resources. The figures I have used are the best estimates now available. But we must be sure, and we must begin now to make provision for the future.

"Conservation in terms of the national interest means the intelligent use of our resources with a due regard for the future. It does not mean skimping ourselves today so as to have abundance a hundred years from now. But it does mean knowing as accurately as possible how we stand and making our plans accordingly. Conservation means careful mining to avoid the irretrievable loss of valuable minerals. It means the development of new technology which in the future will open up low-grade deposits which are now commercially out of reach. It means finding substitutes for scarce materials, and preventing their frivolous use in forms that add nothing worth while to the standard of living."

Ninety-Cent Silver Rider Remains on Treasury Bill

Silver legislation took another peculiar turn during June, and indications were that the 90.3c per ounce price would become law via the Treasury-Postoffice appropriation bill.

There was one probable qualification to the victory of the silver senators—it was believed that to satisfy the Treasury, the $1.29 Government purchase price in two years would be dropped from the bill.

Observers on Capitol Hill believe that, if the $1.29 price is stricken from the Treasury-Postoffice measure, the silver senators would either amend the Murdock bill, which contains exactly the same language as the Treasury bill rider, or write a new bill which would provide for the $1.29 price in two years. Whether the attempt to fix the higher price would be launched during the current session of Congress or not was not known.

ICC Grants Six Percent Freight Rate Increase

Effective July 1, the Interstate Commerce Commission has authorized a general 6 percent increase in freight rates, with certain exceptions. Eastern roads were granted an additional 5 percent to equalize their rates with those of other areas. This increase is temporary, pending a decision on the carriers' request for a 25 percent increase.

The 6 percent hike applies to all commodities except agricultural products, livestock, and "low-grade products of mines," such as sand, gravel, broken rock, and slag. These commodities were given a 3 percent increase. The term "low-grade products of mines" does not apply to ores and concentrates. It does include bentonite, borate rock, china clay, asphalt, clay, coal pyrites, crushed limestone, dolomite, earth, feldspar, fireclay, fluxing stone, ganister rock, iron pyrites, kaolin, and shale.

The 5 percent increase for Eastern (Official Territory) roads does not apply to coal or iron ore. The rates on iron ore will be increased 2c per gross ton in the East and 3c in the Southern and Western territories and 3½c per ton net or gross on interterritorial traffic.

OPA Veto Leaves Status Of Premiums in Doubt

Even though the Senate surprised the Administration by giving the OPA extension measure even rougher treatment than the House accorded it, provisions for subsidies to copper, lead, and zinc producers remained intact in the bill passed by the Senate June 13.

The Senate version continued OPA until June 30, 1947, with drastically curtailed powers. The bill provided for removal of controls on non-agricultural products whenever supply deficiencies are overtaken. Food subsidies were to end May 1, 1947. Metal subsidies were to continue until June 30, 1947.

The differences between House and Senate versions were quickly settled in conference. However, the President surprised most observers by fulfilling at the eleventh hour his earlier threat to veto any bill which would hamstring OPA as much as the House version. After the veto, the legislation quickly died when the House failed to override the veto.

The President had hoped to stampede Congress into a last minute blanket extension of OPA but the strategy failed. The move to extend OPA temporarily until Congress could consider the President's recommendations for revising the legislation was blocked in the Senate. Thus OPA officially passed out of existence after June 30. A week later it was still in doubt whether Congress would agree on price control legislation acceptable to the Administration or let prices take care of themselves.

The premium-quota system, important to many producers of copper, lead, and zinc, and an important factor in price determination, lapsed officially with the demise of OPA. However, inasmuch as this program had not been a subject of controversy, during the second week in July it was believed that separate legislation renewing the premium system had a fair chance of passage. Companion bills providing for this, and transferring the personnel and authority to RFC were introduced early in July.

Meanwhile, the upset of price control and the lapse of premiums caused a chaotic situation in the metal markets and in affected mining districts. Lead and zinc prices advanced almost immediately to 9.50 cents (New York and St. Louis, respectively). No copper changed hands during the first few days of July, thus no market was established. Foreign purchases by the Government were also held up, as these transactions involved the subsidy powers vested in OPA.

Most of the copper, lead, and zinc mining areas were continuing production temporarily and awaiting developments in the belief that most of the production would be sustained by higher prices if not by premiums. The outstanding exception was the Tri-State district, where 80 percent of the production shut down. Only four operators maintained production in this area.

Items Restored in Final USGS And USBM Appropriation

The original budget estimates for the Bureau of Mines and the Geological Survey for 1947, cut in half by the House of Representatives in its consideration of the Interior Department appropriations bill, were about 80 percent restored by a conference committee report which was accepted by both houses, sent to the President late last month, and signed early in July.

In the Geological Survey item in the bill, Congress granted appropriations totaling close to $10 million. The House had pared the $10 to $8 million and the Senate restored it to the budget estimate of close to $13 million. Items reduced in the final bill included topographic and geologic surveys, investigation of Alaskan resources, stream gaging, classification of lands, printing and binding, and mineral leasing.

The Bureau of Mines was granted slightly over $16 million, $4 million short of its original budget estimate. The House had pared the estimate down to $11 million and the Senate restored the figure to budget level. Items cut in the final bill included salaries and expenses, testing fuel, synthetic liquid fuels, mineral mining investigations, investigation and development of domestic mineral deposits, coal, oil, and gas investigations, mining experiment stations, metallurgical research and pilot plants, economics of mineral industries, helium utilization and research, and buildings and grounds improvements at Pittsburgh, Pa.

Geological Survey Plans An Extensive Program

In preparation for its peacetime responsibilities, the Geological Survey has planned an elaborate, long-range program on an unprecedented scale. Some features of the program are detailed herewith.

Less than 10 percent of the country has been mapped geologically on scales adequate for modern purposes, according to the Survey. This country ranks next to the bottom of the list of nations carrying on mapping programs in terms of percentage of total area mapped. The Survey plans to rectify this by a comprehensive, long-range mapping program.

It is estimated that, with the improved geologic mapping techniques now available, this program will require about 30 years' work and will cost approximately $130 million. In order to build soundly and yet obtain the earliest returns in terms of new mineral reserves and other values, the Survey's budgets will have to be increased gradually over an interval of four years.

The 1946 cost estimate is $1,188,300. In 1947, the cost would be $2,463,500. It will call for $3,750,000 in 1948, $4,500,000 in 1949, and $5,000,000 in 1950. The 1950 base is to be maintained thereafter until the major mapping objective is achieved, according to the Survey.

Among the projects planned in this program are the following: The division of soil survey, Department of Agriculture, has requested detailed map surveys at the rate of approximately 10,000 square miles a year, beginning this year, to serve as a basis and guide for detailed soil surveys; detailed geological maps covering a 75-mile-wide strip around the entire border of the U.S. for the War Department; systematic geological mapping of islands in the Marianas, Carolinas, Palau, Bonins, Ryukyus, and the Philippines, for the War Department; mapping of nine national parks and monuments for the National Park Service; maps of states and smaller areas of special interest for Montana, Massachusetts, Rhode Island, in cooperation with those states.

Because of the lack of available trained geologists in Government agencies, both federal and state, and in industry as a whole, the Survey is initiating immediate action on an adequate "in-service" training program for young geologists as they become separated from the armed forces. The Survey will, through the cooperation of the Veterans' Administration and universities staffed and equipped to afford a high standard of review instruction, provide six-month field courses to those completing the college refresher course. The students, on completion of the refresher courses, will be given special six-month appointments on the Survey at entering grades commensurate with their training.

Quantitative spectroscopic analysis now makes it possible to obtain rapid

(*Continued on page* 138)

NEWS OF THE INDUSTRY

Major Metal Producers Reach Strike Accord

A rift in the long unbroken nonferrous strike front came on June 11 with the signing of an agreement between the International Union of Mine, Mill and Smelter Workers, CIO, and the American Smelting & Refining Co. covering about 5,000 workers in 18 plants. Contracts similarly negotiated with the U. S. Smelting, Refining & Mining Co., Utah Copper Co., and Utah properties of A.S.&R. were approved by the Utah district union policy committee on June 15 and quickly ratified by the locals. A settlement was also reached in the Western mining division of Phelps Dodge Corporation, but the men refused to return to work pending negotiation of issues at the corporation's El Paso, Tex., and Laurel Hill, N. Y. Final settlement was announced on June 27.

Countering the otherwise steady trend toward labor peace in the industry was a strike called on June 17 against the New Jersey Zinc Co. by 1,000 members of District 50, United Mine Workers, AFL, at the company's two mines at Franklin, N. J. The strikers are demanding a wage increase of 18½c hourly. The strike is said to be the first in the company's history.

The basis of the American Smelting & Refining Co. agreement was an increase of 18½c per hour effective on resumption of operations, with provision for retroactive wage payments varying in amount and period according to local conditions. Employees at the Tacoma, Wash., plant, for example, received the full 18½c retroactive to Oct. 1, 1945; at Perth Amboy and Newark, N. J., 9¼c retroactive to Nov. 13 and Nov. 10, 1945, respectively; at El Paso, Tex., a graduated scale of payments retroactive to Oct. 1, 1945, ranging from a minimum of ¼c for highest paid to a maximum of 7½c for lowest paid workers. Salaried employees at several of the company's plants received basic salary increases of $32 per month, half of this retroactive to October or November, 1945.

The A.S.&R. agreement is to run until June 30, 1947, and contains "no strike" and "no lockout" provisions applicable to all plants.

Following the same pattern, the United States Smelting, Refining & Mining Co., Utah Copper Co., and A.S.&R. Utah plant settlements call for an 18½c hourly wage advance, with half of the amount retroactive to Sept. 1, 1945, for all production workers. Pitmen at the Utah Copper Co. are raised from $6.15 to $6.45, and from $6.35 to $6.65 per shift, retroactive to Sept. 1, 1945. Labor rates for the other two companies remain at $6.45 per shift. Clerical and technical workers received the same increases as called for in the main A.S.&R. agreement. The contracts extend for two years, effective July 1, 1946, but may be opened for wage rate discussion after one year.

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Vanadium Concerns Indicted On Charges of Monopoly

Indictments returned against six corporations and five individuals on June 27 by a U. S. grand jury convened in Denver, Colo., in July 1945, charge a conspiracy which had brought about a monopoly of the mining and selling of vanadium and vanadium-bearing ores in the U. S., squeezing out all independent mine and mill operators. Defendants include the Union Carbide & Carbon Corporation and its wholly owned subsidiaries, the U. S. Vanadium Corporation, Electro Metallurgical Co., Electro Metallurgical Sales Corporation, and the Electro Metallurgical Company of Canada, Ltd. Also indicted is the Vanadium Corporation of America.

Individuals included in the indictment are D. R. Van Fleet, of New York, president; Blair Burwell, vice president; and W. G. Haldane, vice president, all of U. S. Vanadium Corporation; E. D. Bransome, of New York, president of Vanadium Corporation of America; and F. F. Kett, of New York, general manager of the mining division, Vanadium Corporation of America.

The indictments contend that the defendants control 95 percent of all commercially available vanadium-bearing ore deposits, 99 percent of all vanadium oxide produced, sold, and consumed in the U. S., and 100 percent of the ferro-vanadium. Wendell Berge, Assistant Attorney General in charge of the anti-trust division, charges that independent vanadium miners in the states of Colorado, Utah, New Mexico, and Arizona have been placed completely at the mercy of the defendants.

The indictments specify that U. S. Vanadium Corporation used Government funds to raise prices paid for ore in the neighborhood of small, independent mills, thus shutting off supplies to these operators and driving them out of business; and that the prices paid were determined by U. S. Vanadium without reference or determination of the Metals Reserve Company. It is also charged that U. S. Vanadium refused to buy ore from mines in the vicinity of its own mills and those of Vanadium Corporation of America, forcing the operators of these mines to sell to the two corporations at prices lower than those U. S. Vanadium was paying, as agent, to Metals Reserve Company miners in the vicinity of small, independent mills.

It is specified that U. S. Vanadium Corporation bought a Metals Reserve Company vanadium oxide mill in Colorado, tried unsuccessfully to buy its ore stockpile, then contracted with MRC to extract vanadium oxide from stockpiled ores for a fee, thus eliminating these ores as a source of supply for potential competitors. Vanadium Corporation of America is charged with extracting vanadium oxide from a large ore stockpile found in connection with a Government mill purchased by the corporation in Utah.

Lake Superior Safety Meeting Draws Large Attendance After Wartime Suspension

Attendance of 550 operating men interested in metal-mine safety, and drawn almost wholly from the Minnesota and Michigan ranges, gave the seal of approval to the twenty-second annual Mine Safety Conference held June 20 and 21 at the Hotel Duluth, Duluth, Minn., by the Lake Superior Mining Section of the National Safety Council. No other industry in the country stages an annual convention of the magnitude of this meeting, devoted wholly to the subject of safety, and which the Lake Superior iron-mining companies have supported annually for 22 years, allowing for a five-year gap since 1941 caused by World War II. This keen interest in safety is reflected in the excellent safety records achieved in Lake Superior iron mining both in the open pits and the underground mines.

W. T. McCormick, safety director for Inland Steel Co.'s iron mines, presided as general chairman of the Mining Section. Byron G. Best, of Oliver Iron Mining Co., was vice chairman, and Frank E. Cash and E. W. R. Butcher were secretary and treasurer.

(*Continued on Page* 139)

POWER

FULL SHIFT AVAILABILITY IS ASSURED WHEN BATTERIES ARE EXIDE-IRONCLADS

There is no slowing down between shifts . . . no time out for attention . . . when Exide-Ironclads supply the power for trammers, locomotives and shuttle-cars. Full shift availability is assured day after day...and up to the end of every day.

Exide-Ironclads have the *high power ability* that frequent "stop and go" service demands . . . the *high maintained voltage* that mine, tunnel and quarry operations require . . . the *high capacity* that assures steady, full-day performance. And rugged, Exide-Ironclad construction is assurance of dependability, long-life and ease of maintenance.

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A.I.M.E. Calls Conference On World Mineral Problems

A three-day conference of delegates from mineral-producing countries of the world will feature the 75th anniversary meeting of the American Institute of Mining and Metallurgical Engineers in New York in September, according to announcement by Louis S. Cates, president of the Institute, on June 7. Herbert Hoover will serve as honorary chairman.

The agenda of the forum will include discussion of the heavy demands made upon the world's resources of minerals by two global wars and the increased responsibilities laid upon mineral technology by the necessity for new processes and alloys to meet the problems of atomic energy. Views will be exchanged on all phases of the world situation relating to iron and steel, coal, petroleum, non-ferrous metals, and industrial minerals.

International leaders in the fields of science, engineering, industry and government will address the conference. Among the speakers already scheduled are Julius A. Krug, Secretary of the Interior; Sir William Fraser, chairman of the Anglo-Iranian Oil Co.; Charles M. White, president of the Republic Steel Co., and Cornelius F. Kelly, chairman of the Anaconda Copper Mining Co.

AMA Suggests Caution With Aluminum Therapy

A joint report on the use of aluminum in silicosis prevention and treatment has been issued by the Council on Industrial Health and the Council on Pharmacy and Chemistry, American Medical Association. The report reads as follows:

"The dissemination of reports on the effects of aluminum powder in the prevention and treatment of silicosis has aroused widespread interest and a demand for an authoritative statement regarding its value. At the present time the following statement would seem to be warranted; it is subject, however, to such modification as future knowledge and experience may indicate:

"In experimental animals the prophylactic use of aluminum inhibits the toxic action of relatively pure quartz.

"In man, industrial dust exposures often involve mixtures of various minerals in addition to quartz and other environmental variables to which experimental animals are not subject. Therefore, human silicosis usually develops more slowly and is often modified in type. Only prolonged unbiased observation, with adequate control cases, will demonstrate whether the prophylactic results obtained with animals are applicable to man.

"Animal experiments have demonstrated that administration of high concentrations of amorphous hydrated alumina unfavorably influences resistance to tuberculosis. While this result has not yet been reported for metallic aluminum, caution in the application of all aluminum therapy to human beings is recommended.

"The use of aluminum might appear as an easy short-cut to healthful working conditions, thus saving large expenditures for ventilation and other control methods. Actually there is no substitute for the accepted methods of dust control.

"If industry indiscriminately treats all employees with aluminum dust, there may be aggravation of tuberculosis or other pulmonary conditions.

"The therapeutic use of aluminum in man appears to relieve symptoms in a very small number of cases in which silicosis develops rapidly. Experience in some groups is more favorable than in others.

"In view of these considerations it is recommended that the general application of aluminum therapy in industry be delayed until adequately and impartially controlled clinical observation demostrates its effectiveness in preventing or alleviating silicosis in man. In the meantime, there should be no slackening in the control measures that have been found effective in reducing the incidence of dust diseases in industry."

India Moves to Offset Rising Silver Price

The Indian Government has decided to withdraw from circulation subsidiary silver coins of less than one rupee value and to replace them with nickel coinage. This is seen as another effort to check the upward trend of the silver price in that country, a feared result of which could be the melting of rupees for their silver worth. Previous action in reducing the silver content of the rupee failed in its objective of countering the price trend.

India is also concerned over developments in the world silver situation, inevitably coupled with the outcome of current pressure for a still higher silver price in the United States, which may affect seriously her ability to repay in kind large amounts of silver advanced under lend-lease arrangements. The cost of repayment at the present rupee price of silver is estimated to be the equivalent of £50,000,000 sterling.

London financial circles are reported to view the Indian move as a further retreat from monetary use of silver.

Technical Writing Contest Announced by Eimco

Cash awards of $500, $300, and $200 will be presented for the best three papers submitted on the subject, "Mechanical Loading and Related Practices in Hard-Rock Mining," in a technical writing competition for senior and graduate mining students in the United States and Canada sponsored by the Eimco Corporation, of Salt Lake City, Utah. The purposes of the competition, to be held annually, are to promote knowledge of mechanical rock-loading techniques, to present case histories and time studies of successful installations, and ultimately to provide material for a handbook on the subject.

Papers will be judged by a board of representative mining men. Entries must be postmarked on or before Jan. 1, 1947.

Sale of Geneva Plant to U. S. Steel Is Approved

Sale of the Government's $191,000,000 steel plant at Geneva, Utah, to the United States Steel Corporation was approved by Attorney General Tom C. Clark on June 17. The corporation's bid of $47,500,000 for the plant, including iron and coal mines, quarries and inventories, had been approved by the War Assets Administration on May 23.

Under the Surplus Property Law, the Attorney General is required to determine whether a monopoly would tend to result from any sale at a price exceeding $1,000,000. In support of the opinion that the sale, as such, did not constitute a violation of the anti-trust laws, the Attorney General, in a letter to the War Assets Administrator, stated that on Jan. 1, 1946, the ingot capacity of United States Steel Corporation represented 31.4 percent of national capacity and that during 1945 the corporation's sales in dollar volume amounted to 27.6 percent of total dollar sales volume in the industry. He pointed out that whereas the steel industry as a whole experienced a net gain in capacity between 1939 and 1946, the Steel Corporation recorded a slight net decline in its own capacity and a significant decrease in relation to the entire industry. Addition of the Geneva plants, with 1,283,000 tons' capacity, to the present 28,813,200 tons' capacity of United States Steel Corporation would raise its share to only 32.7 percent of the national capacity, he asserted.

Major Molybdenum Deposit Reported in Manchuria

The existence of a large body of molybdenum ore in Manchuria has been reported by geologists attached to the reparations mission, headed by Edwin W. Pauley, which is conducting a survey of former Japanese war industry in that country. News dispatches have referred to the orebody as comparable in size to the Climax, Colo., deposit. Situated at the town of Yang Cha Chan Tze, 40 miles from the Gulf of Liaotung, the mine is said to have been worked by 6,000 Chinese laborers and a staff of 300 Japanese technicians, producing an average of 400,000 metric tons of ore per year during the war. Japanese estimates of ore reserves are quoted at 8,000,000 tons of unstated grade. This compares with estimated reserves of 260,000,000 tons for the Climax deposit. Production has dropped to 600 tons a month since the plant was wrecked in September 1945.

Ryerson—Quick Source for

INLAND 4-WAY FLOOR PLATE

Take a careful look at this close-up of Inland 4-Way Floor Plate. Note the 4-way projections.

Now read of the advantages Inland 4-Way Floor Plate provides:

1. *Safer traction* on walkways, stairways, around machinery and wherever sure footing is important. The 4-way projections grip feet or wheels from every angle. Give 4-way protection against dangerous falls.

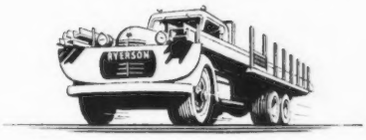
2. *Longer wear.* Inland floor plate is rolled from tough, open hearth steel with high wear resisting qualities.

3. *Great structural strength.* The overlapping projections reinforce lengthwise and crosswise giving Inland 4-Way Floor Plate greater stiffness. It has a tensile strength of 55,000 lbs. and an elastic limit of 35,000 lbs. per square inch.

Then you get the additional advantage of a continuous pattern that is pleasing in appearance; matches whether laid side to side or end to end and permits sweeping and drainage in four directions.

Inland 4-Way Floor Plate is available for quick delivery from Ryerson Steel-Service Plants, in two pattern sizes and several thicknesses. Write for catalog and samples too if you care for them.

JOSEPH T. RYERSON & SON, INC. Steel-Service Plants at: Chicago, Milwaukee, Cleveland, Cincinnati, St. Louis, Detroit, Philadelphia, Pittsburgh, Buffalo, Boston, New York.



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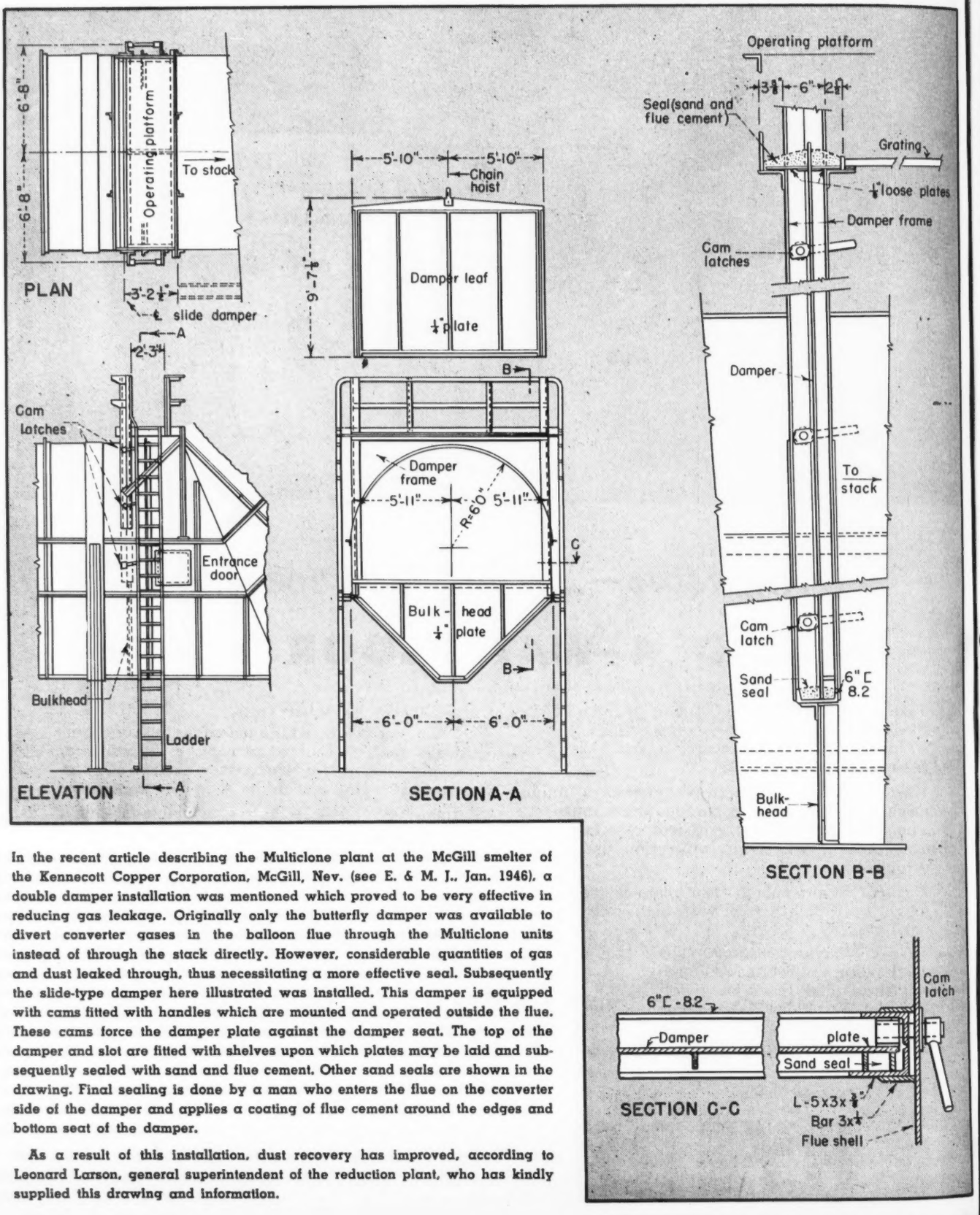
Ryerson stocks of seamless mechanical tubing, boiler tubes and Allegheny Stainless tubing are large and complete. Contact nearest Ryerson plant for prompt delivery.

RYERSON STEEL

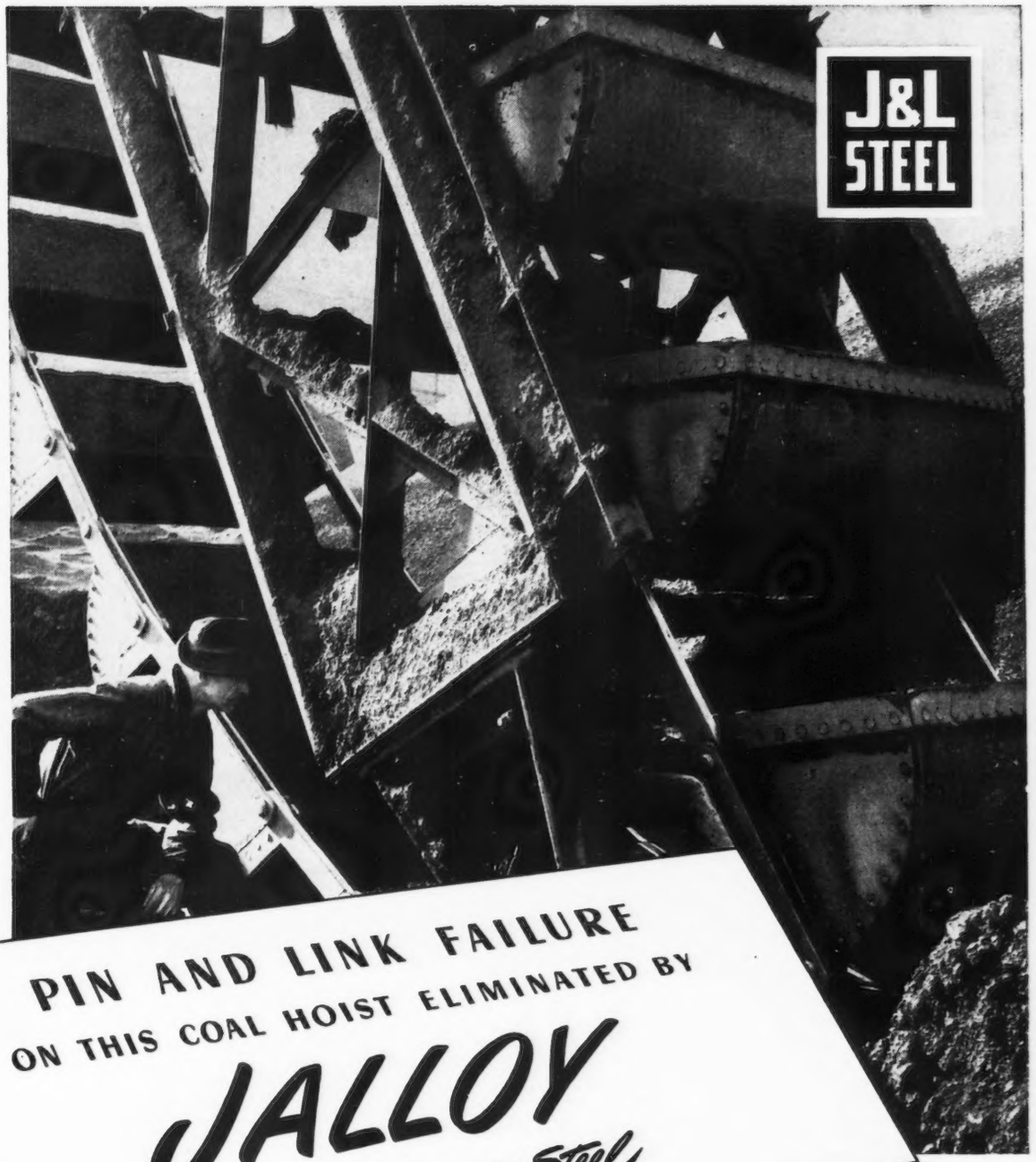
OPERATING IDEAS

Gas Leakage Is Cut by Slide-Type Damper



In the recent article describing the Multiclone plant at the McGill smelter of the Kennecott Copper Corporation, McGill, Nev. (see E. & M. J., Jan. 1946), a double damper installation was mentioned which proved to be very effective in reducing gas leakage. Originally only the butterfly damper was available to divert converter gases in the balloon flue through the Multiclone units instead of through the stack directly. However, considerable quantities of gas and dust leaked through, thus necessitating a more effective seal. Subsequently the slide-type damper here illustrated was installed. This damper is equipped with cams fitted with handles which are mounted and operated outside the flue. These cams force the damper plate against the damper seat. The top of the damper and slot are fitted with shelves upon which plates may be laid and subsequently sealed with sand and flue cement. Other sand seals are shown in the drawing. Final sealing is done by a man who enters the flue on the converter side of the damper and applies a coating of flue cement around the edges and bottom seat of the damper.

As a result of this installation, dust recovery has improved, according to Leonard Larson, general superintendent of the reduction plant, who has kindly supplied this drawing and information.



PIN AND LINK FAILURE ON THIS COAL HOIST ELIMINATED BY JALLOY

The Tank Armor Steel

Maintenance on the coal hoist above was a constant problem because of repeated failure of the links and pins on the bucket conveyor. All pins and links were replaced with new ones made of Jalloy, the special J&L steel made for tough jobs involving heavy impacts and dynamic stresses. Since then down-time because of pin and link failures has been eliminated—costly maintenance work has been avoided. Write for information about Jalloy steel.

JONES & LAUGHLIN STEEL CORPORATION

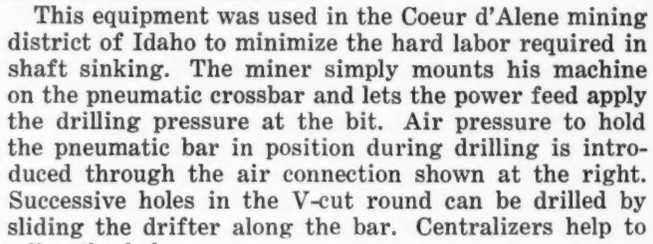
PITTSBURGH 30, PENNSYLVANIA

Drifter Mounted on Pneumatic Bar for Shaft Sinking

Perhaps you have heard the story of the shaft that was sunk so badly out of plumb that the last rounds had to be drilled with a stoper. This doesn't happen to be that shaft, nor is it out of plumb despite the use of drifters instead of sinkers.

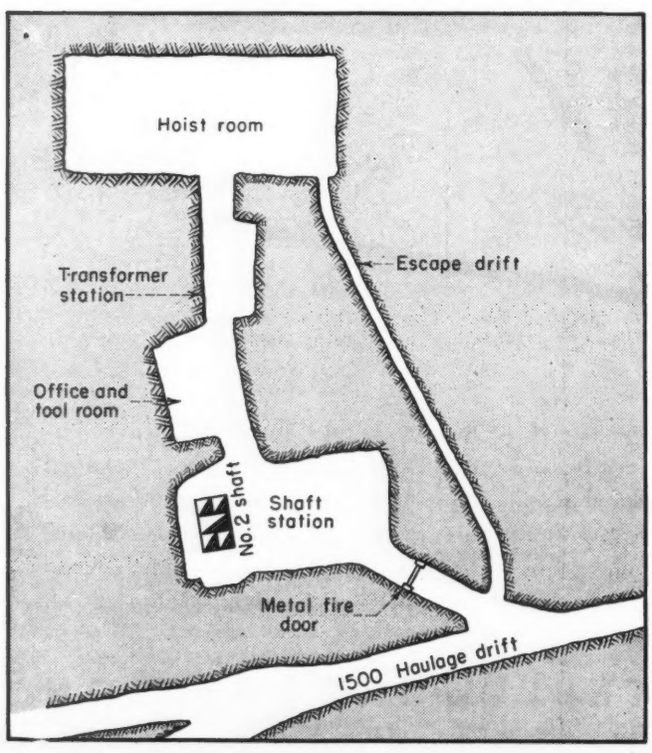
This equipment was used in the Coeur d'Alene mining district of Idaho to minimize the hard labor required in shaft sinking. The miner simply mounts his machine on the pneumatic crossbar and lets the power feed apply the drilling pressure at the bit. Air pressure to hold the pneumatic bar in position during drilling is introduced through the air connection shown at the right. Successive holes in the V-cut round can be drilled by sliding the drifter along the bar. Centralizers help to collar the hole.

Safety Suggestion



When hooks, used to dislodge rocks from grizzly rails, are lying on the ground or hanging from walls, it is possible for workmen to step on or bump into the prongs. This hazard can be avoided by constructing the handle parallel to the hook, instead of at right angles to it, according to C. W. Abrahamson, safety engineer, Horne mine, Noranda Mines, Ltd., Quebec.

Escape Drift Provided for Fire Emergency



Operators of the new hoist on the 1,500 level of the copper property of the Howe Sound Co., Chelan Division, Holden, Wash., are provided with an escape drift for protection in the event of a fire. The complete layout consists of a large hoist room containing a 600-hp. ore hoist and a 150-hp. man hoist; a transformer station; a shifters' office and tool room; and a shaft station to serve the five-compartment No. 2 shaft. Access to these rooms is afforded by a short drift driven off the 1,500 haulage level.

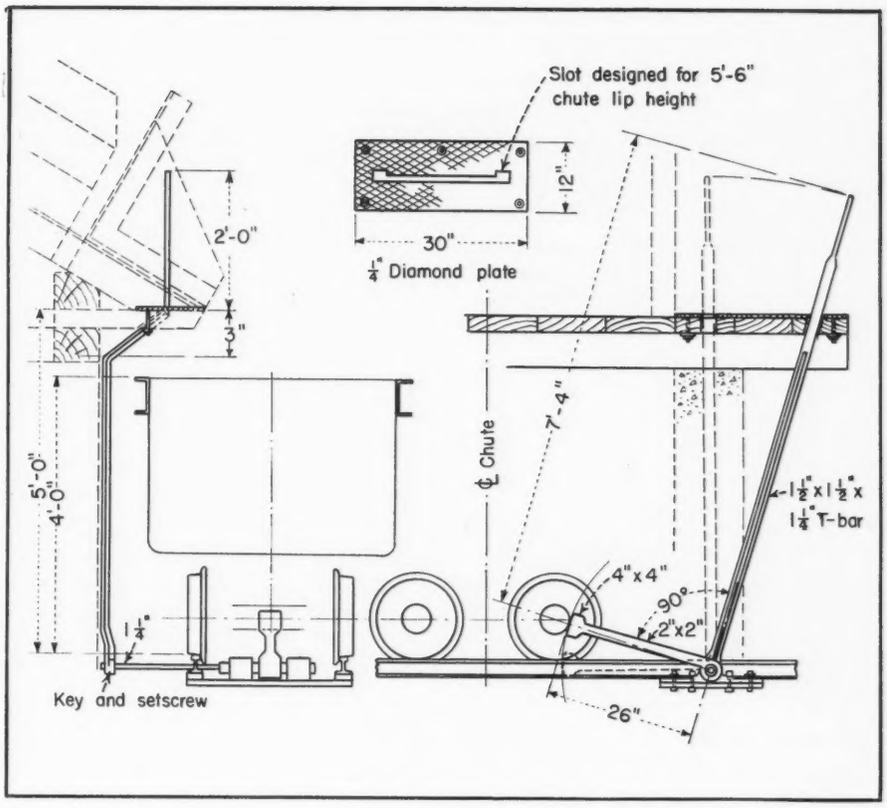
As operators in the hoist room would be trapped if fire were to break out in any of the other rooms, an emergency exit was provided by driving the escape drift shown in the accompanying plan. This permits operators to leave the mine via the 1,500 drift and portal, which is a considerable distance from the shaft station.

Car Stop Is Designed for Safer Loading

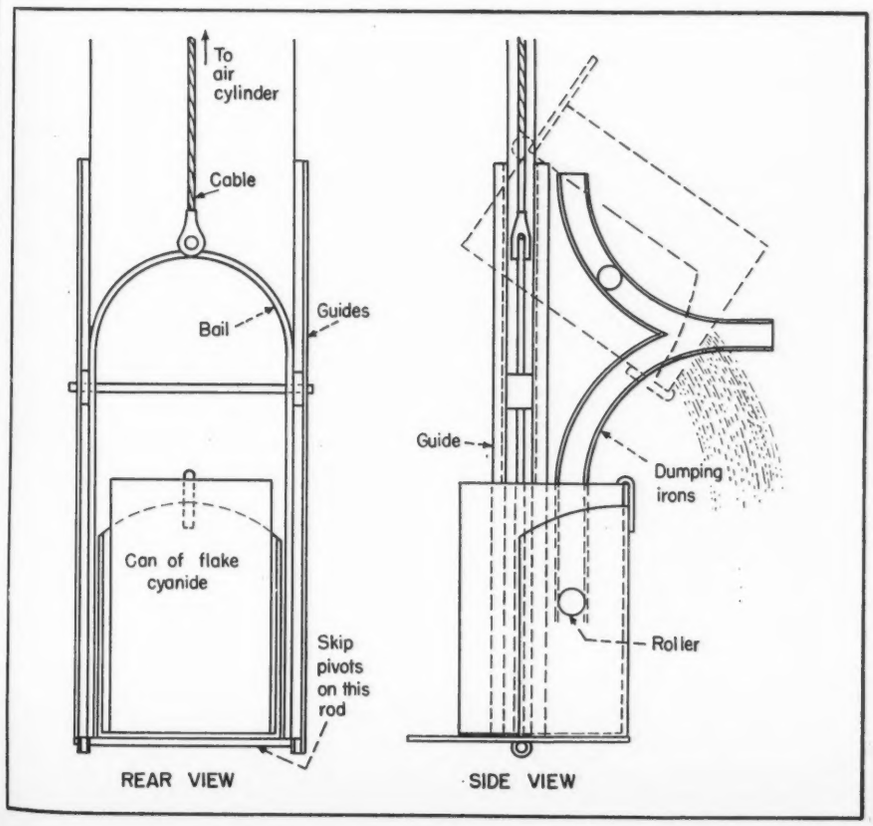
This car stop was designed to reduce labor requirements and accidents in chute loading, by C. W. Abrahamson, safety engineer, Horne mine, Noranda Mines, Ltd., Quebec.

Originally, empty cars were hauled to loading areas by a motor crew and let down a ½ to 1 percent grade on chute-loading tracks. Motor crews hauled loaded trains to the shaft while loaders filled the empty trains. The forward, or upgrade, car was held in place by a chain placed in front of the car wheel. This was removed to allow the cars to roll in front of the chute, whereupon the wheel was again blocked. Three men were required, one man to spot the cars, and two to load them. Occasionally men would get their fingers jammed while trying to prevent cars from over-running loading positions.

After the new car stop shown here was designed, chute loading accidents were virtually eliminated and one man could be removed from each loading crew. Note, also, the design of the chute lip, which speeded loading and helps notably to curtail accidents.



Cyanide Dumping Chamber Protects Mill Operators



The hazards of exposing men to cyanide fumes and dust, and accompanying irritating skin rashes resulting from dumping cyanide cans by hand, have been eliminated at the Kerr-Addison mill, Virginiatown, Ont., by the dumping device illustrated in this sketch, submitted by George Hawkes, metallurgist.

A small wooden chamber incloses this device, which is identical to those used in headhouses to dump mine skips. An air cylinder raises the "skip" after a can has been placed upon it. The can is dumped into a hopper of a reagent feeder, which discharges into conditioner tanks. Workmen remain outside of the inclosure during dumping operations, and fumes and dust in the inclosure are exhausted to the atmosphere. The helpful comments of N. W. Bennet, mill superintendent, who authorized release of this information, are gratefully acknowledged.

NEW BOOKS

YEARBOOK OF THE AMERICAN BUREAU OF METAL STATISTICS. American Bureau of Metal Statistics, 33 Rector St., New York 6, N. Y. Pp., 112. Price, $3, postpaid.

The 1945 edition marks the 25th annual appearance of this authoritative statistical summary of the non-ferrous metals industry. Restrictions on the publication of metals statistics have been rescinded, and the current issue contains data not available in the war years.

THE METALLURGY OF STEEL CASTINGS. By Charles Willers Briggs. McGraw-Hill Book Co., New York. Pp. 663. Price $6.50.

Mr. Briggs, who is technical and research director for the Steel Founders' Society of America, had as his objective, in writing this book, the production of a useful reference work for all who are concerned with the design, production, and use of high-grade steel castings, both in the immediate industry producing them and in other industries, and to students as well. Attention throughout is directed to technical and metallurgical control. Among the various aspects of the subject the respective chapters cover practice for basic and acid production; tapping and pouring; liquid contraction, fluidity, solidification, and contraction; molding sands and cores; and casting defects. Cleaning, chipping, and grinding are also discussed; likewise heat-treating, metallography, welding, and inspecting. Separate chapters are devoted to gases, deoxidation, porosity, and inclusions.

MINERAL RESOURCES OF THE MISSOURI VALLEY REGION. Missouri Basin Studies No. 1. Four sheets. Compiled by D. M. Larrabee, S. E. Clabaugh, and D. H. Dow. Prepared by the U. S. Geological Survey for the Bureau of Reclamation, Washington, D. C., 1945. Price $0.40.

A veritable encyclopedia of information on the mineral resources of the twelve-state area drained by the Missouri River and its tributaries is presented on a series of four color maps, each approximately 34 in. by 42 in., recently published by the Geological Survey in connection with the Bureau of Reclamation's two-billion-dollar Missouri Basin Plan. States included in the mapping are: Missouri, Iowa, Kansas, Nebraska, South Dakota, North Dakota, Colorado, Wyoming, Montana, and parts of Utah, Idaho, and Minnesota.

Produced on a scale of 1:2,500,000, or about 39 miles to the inch, the four main maps depict by color differentiation the basic geology of the region, subdivided into sedimentaries, volcanics, Pre-Cambrian rocks, and younger igneous intrusives. Structure contours are shown at 500-ft. intervals.

Part I, dealing with metallic mineral resources, is of particular interest to readers of *Engineering and Mining Journal*, and exemplifies the research effort that has gone into preparation of the maps. Key symbols show the location of precious and base metal deposits and the production in each area between 1939 and 1943 according to whether major values were in gold and silver or in copper, lead, and zinc. The same symbols are circled to indicate production valued at more than $500,000 in any one year. Other symbols are used to locate deposits of ferrous, ferro-alloy, and minor metals.

Smaller scale, black and white inset maps show the source and value of past production of precious and base metals by counties; source and value of ferrous, ferro-alloy and minor metal production; and location, capacity, and product of mills, smelters, and refineries.

Parts II, III, and IV depict the region's known resources of non-metallic minerals, fuels, and construction materials.

The maps constitute a well-integrated and easily interpolated compendium of essential facts about the resources of an area which looms large in our mineral economy. The U. S. Geological Survey and the authors are to be commended.

THE WAGNER ACT: AFTER TEN YEARS. Edited by Louis G. Silverberg. The Bureau of National Affairs, Inc., 24th and N St., N.W., Washington, D. C. Pp. 126.

Mr. Silverberg, director of information for the National Labor Relations Board, has collected a volume of highly interesting comments on the successes and failures of the National Labor Relations, or "Wagner," Act. The book is worth reading; in fact, it is required reading for anyone who wants to try to keep his thinking straight as Congress begins ponderously to deal with national labor problems.

In this book, Senator Wagner, his former secretary, former members of the NLRB, a union executive, and others connected with administering the Act contribute essays analyzing the intent, the accomplishments, and possible amendments to the Wagner Act. It need surprise no one that all these men conclude that the Wagner Act has fulfilled the intent of its makers and that not a line of it should be touched.

Lee H. Hill, as the sole representative of management in the volume, offers amendments to the Act designed to remove the obvious inequity that now exists in the treatment accorded employers under the Act. He is a voice crying in the wilderness.

One might write at length on the ideas put forth in this book, but that is hardly called for in a review. It is enough to say that to understand why the Wagner Act was created and why it was deliberately administered in as one-sided and prejudiced a way as possible, one ought to read this book.

In closing, I'd like to add an estimate of the Government's labor policy, and the Wagner Act, that appeared in a *New York Times* editorial on May 17, 1946. It runs: "the Government labor policy of the last dozen years is now bankrupt. Instead of promoting industrial peace, it has promoted industrial strife, and such peace as it has been able to obtain has been bought only at the cost of steadily mounting ransom. An entirely new labor policy has become imperative." That, not Mr. Silverberg's whitewash, is the Wagner Act ten years after.

R.H.R.

PUBLICATIONS RECEIVED

South Australia. Mining Review for half year ended Dec. 31, 1944. Department of Mines, Adelaide. Pp. 111.

Oregon. "Mineralogical and Physical Composition of the Sands of the Oregon Coast from Coos Bay to the Mouth of the Columbia River." Department of Geology and Mineral Industries, Portland 5, Oregon. Pp. 64. Price 35c.

Venezuela. Review of activities 1936-1946 of Technical Service of Mining and Geology. Ministry of Fomento, Caracas. Pp. 74.

The U. S. Geological Survey has issued the following bulletins, which may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., at the price given in each case:

"Chromite-Bearing Sands of the Southern Part of the Coast of Oregon." Bulletin 945-E. Pp. 113 to 150, plus maps. Price 55c.

"Minerals of the Montmorillonite Group. Their Origin and Relation to Soils and Clays." Professional Paper 205-B. Pp. 79. Price 35c.

"Mineral Investigations of the Geological Survey in Alaska in 1943 and 1944." Bulletin 947-A. Pp. 6. Price 5c.

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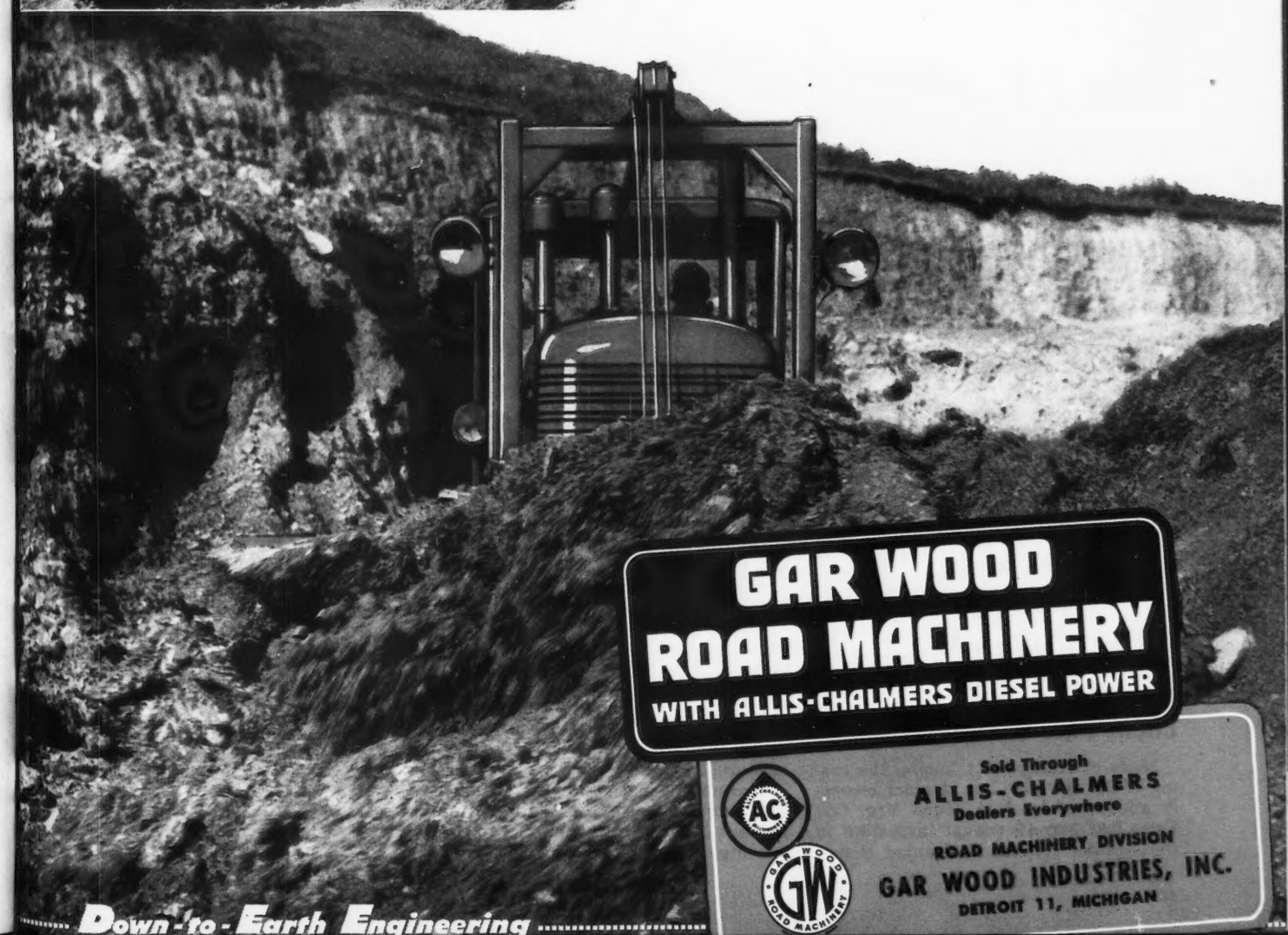

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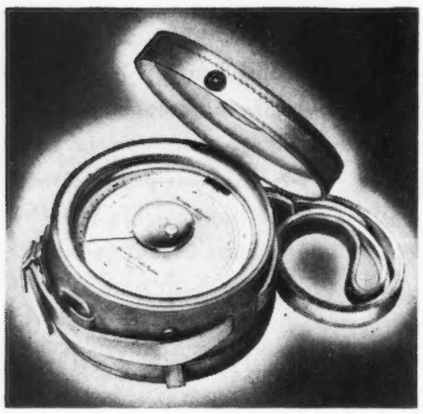
Down-to-Earth Engineering

EQUIPMENT NEWS

Surveying Altimeter

An aneroid altimeter built on a new principle and said to be particularly effective for preliminary field surveys has been announced by American Paulin System, Los Angeles, Calif. The instrument is made in several models to cover all possible ranges of elevation above and below sea level, and it is said to have a sensitivity to elevation changes of better than one part in 12,000, and to be accurate within one part in 1,000.

The Paulin instrument does not use the chain-and-lever principle used by



other aneroid altimeters, but transmits diaphragm movement directly, without friction, to the dial, which is read in terms of inches' pressure or altitude in feet. Made in Sweden before the war, the entire line of Paulin instruments is now being manufactured in the United States. The Altimeter is said to be capable of withstanding rough field service. It is supplied with a leather carrying case; the gross weight is 2 lb; and diameter of the dial is 4¾ in.

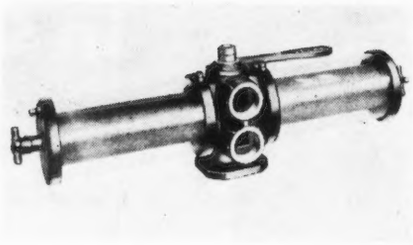
Bagging Scale

Semi-automatic operation is one feature of the new OK Bagging Scale recently announced by OK Scale Co., Buffalo, 13, N. Y. The device will fill, and accurately weigh, up to six 100-lb. burlap, cloth, or paper bags per minute.

A controlled weight indicator removes guesswork and speeds up weighing.

Lucite Pipe Strainer

Made of transparent Lucite, the casing of the new pipe line strainer recently announced by J. A. Zurn Mfg. Co., Erie, Pa., permits visual inspection of the strainer screen. If cleaning is necessary, the flow can be diverted to the other basket while the fouled screen is removed and cleaned. Flow area through the unit is at a ratio of 16 to 1 with 12-in. tubes, and 8 to 1 with 8-in. tubes. Strainer baskets are available in brass, Monel, or other metal.

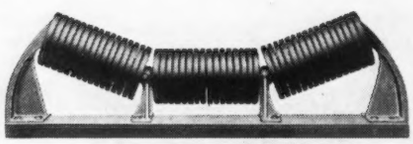


Remote-Controlled Truck

Truck-mounted cranes are given a new flexibility by a device just announced by Harnischfeger Corporation, Milwaukee 14, Wis.; which permits the crane operator to control movements of the truck through a simple push-button panel in the crane cab. With this panel, the crane operator can start the truck engine, operate the clutch, shift gears, steer the truck, apply the brakes, and even blow the horn, without leaving the crane cab. Compressed air, controlled by electrical equipment, does the trick.

Impact-Cushioning Idler

Impact of material on belt conveyors at the loading point is one of the prime causes of belt wear, and the new loading-point troughing idler recently announced by Chain Belt Co., Milwaukee, Wis., has been designed to protect belts from this form of damage. Each roll of the idler consists of a rubber cylinder vulcanized directly to the assembly tube. Molded into each cylinder are multiple grooves, both deep



and shallow, to guard against belt carcass rupture and cover laceration. It is recommended that three or four of these units be used at loading points, spaced at one-half the usual idler spacing.

INDUSTRIAL NOTES

The New York office of **Sterling Engine Co.**, formerly in the Chrysler Bldg., has been moved to 401 Fourth Ave., New York 16, N. Y.

Colorado Fuel & Iron Corporation announces that **Jerry Sabin** has been appointed director of advertising, and **Matthew R. Rosse** has been appointed export manager.

Hewitt Rubber Corporation has changed its name to **Hewitt-Robins, Inc.**, thus bringing in the identity of its wholly owned subsidiary, **Robins Conveyors, Inc.**

Harvey B. Wallace, president of **Wheel Trueing Tool Co.**, has been elected head of the newly formed **Industrial Diamond Association of America.**

Carl O. Wold, vice-president of **Caterpillar Tractor Co.**, has retired after 40 years in the heavy-construction machinery industry.

George E. Gates has been appointed a staff member of **Worthington-Ransome Construction Equipment Division of Worthington Pump & Machinery Co.**, San Francisco, Calif.

Announcement is made of a change in name of **Marion Steam Shovel Co.** to **Marion Power Shovel Co.**, Marion, Ohio.

Eutectic Welding Alloys Corporation announces appointment of **I. B. Mitchell** as advertising manager.

Following a tour of duty with the Navy, **Robert S. Green** has become president of **A. P. Green Fire Brick Co.**, Mexico, Mo., succeeding his father, **Allen P. Green.**

Thomas A. Cantrell has been named head of field engineering for **Euclid Road Machinery Co.**, Cleveland, Ohio, and **George M. Perry** has become assistant export manager.

BULLETINS

Augur Drills. Vertical augur drills used in prospecting for various non-metallic minerals are described in a new bulletin of Paris Mfg. Co., Paris, Ill., which contains details on the new Parmanco vertical drill.

Cranes. One-man aero cranes of the Orton Crane & Shovel Co., 608 South Dearborn St., Chicago 5, Ill., are described in Catalog 73, just released by the company.

Goggle Cleaning. A new bulletin has been prepared by Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh, Pa., on the company's goggle-cleaning cabinet that provides fluid and tissues for this purpose.

Flame Hardening. Apparatus and methods for flame-hardening are discussed in a new publication of Air Reduction Sales Co., New York 17, N. Y. Ask for catalog No. 90.

Electrical Codes. Changes in the 1946 electrical codes are listed and interpreted in a new bulletin prepared by Anaconda Wire & Cable Co., 25 Broadway, New York 4, N. Y.

Vibrating Screens. Pioneer Engineering Works, 1515 Central Ave., Minneapolis, Minn., announces publication of a 16-page bulletin on vibrating screens for pit, mine, and quarry.

MODERN, LOW COST MINE HAULAGE —Now a Must!

Philco "Thirty" Shuttle Car Storage Battery is identified by its distinctive red connectors

There's no time to lose in getting mine haulage costs on a competitive cost-per-ton basis. Modern battery-powered locomotives, trammers and shuttle cars are a *must.* And for power to keep such equipment working at capacity, *at lowest cost,* specify the newest in motive power Storage Batteries, the sensational Philco "Thirty" that gives 30% longer life.

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FOR 50 YEARS A LEADER IN MINE STORAGE BATTERY DEVELOPMENT

PERSONAL NEWS

H. A. Quinn, Jr., has been made resident engineer at the Discovery Yellowknife gold property, north of Yellowknife, N. T.

Prof. H. R. Hanley, chairman of the metallurgical department at the Missouri School of Mines and Metallurgy, has been awarded the degree of professor emeritus, in recognition of his 45 years of outstanding service in the metallurgical industry and as a teacher. Professor Hanley will retire this fall to devote more time to research, particularly in the field of electrical metallurgy.

Donald L. Masson has accepted the post of assistant professor of mining at the School of Mineral Industries, State College of Washington, Pullman, Wash.

Ian L. Reid has become chief engineer for Oliver Iron Mining Co. on the Vermilion Range. He succeeds **W. P. Wolff,** now the company's chief engineer on Mesabi Range.

George W. Danehy is reopening the old Pittsburgh mine, at Central City, Colo.

H. S. H. Donald, Government Mining Engineer in South Africa since 1942, retired in May. He is succeeded by **H. Gabriel Malherbe,** Deputy Government Mining Engineer since December 1943.

L. B. Slichter has been appointed to the chair of geophysics in the department of geology and physics at the University of Wisconsin.

Louis C. Ball, formerly with Alcoa Mining Co. at Bauxite, Ark., and now with the Permanente Metals Corporation, served as ensign in the Naval Reserve from September 1944 to April 1946.

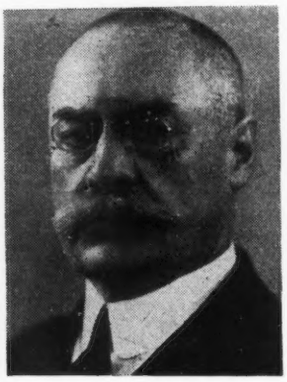
A. T. Broderick, mining geologist, has joined the geophysical firm of **Hans Lundberg** and has established headquarters at Bathurst, New Brunswick, Canada.

Elton A. Youngberg has joined the staff of Howe Sound Mining Co. at the Holden Mine, at Lake Chelan, Wash. He was until recently with the Oregon State Department of Geology and Mineral Resources at Grant's Pass, where he has been succeeded by **Hollis M. Dole,** who recently returned to the United States after three years' service with the Navy in the South Pacific.

J. R. Davies is directing development work at the Red Cloud quicksilver property in Jackson County, Ore.

Stephen R. DuBravac has been appointed deputy mine inspector for Nevada, at Las Vegas, replacing **Mervin J. Gallagher,** who is now foreman for Consolidated Chollar Gould & Savage Mining Co. at Virginia City, Nev.

Dr. N. J. Truschkoff, professor of Leningrad Mining Institute, doctor of science, and distinguished ore-mining consultant and specialist of the U.S.S.R., celebrated his 70th birthday anniversary on May 12 last. Dr. Truschkoff is an alumnus of Leningrad Mining Institute, which was founded in 1773, and author of books on ore



DR. N. J. TRUSCHKOFF

mining, drilling, and sampling and estimating of ore deposits, and has in preparation a volume on mining of ore deposits, summarizing practice in the U.S.S.R. and in other countries. He is familiar with mining practice in the United States, and has popularized American methods and equipment in the U.S.S.R.

Arthur H. Lawry has accepted the post of consulting engineer for the Wingfield and Goldfield Consolidated Mines properties, in Nevada. Mr. Lawry is an alumnus of the Royal School of Mines, at London.

George F. Murphy, for 22 years in the engineering division of the Aluminum Company of America, has become supervisor of the construction division of the company, succeeding **Victor J. Hultquist,** who has retired from that position. Mr. Hultquist will continue his post of city manager of Alcoa, Tenn., a position he has held since 1919.

Dr. N. R. Junner, recently on the staff of Gold Coast Geological Survey, has been made consulting geologist to Selection Trust Ltd., a London holding company with extensive interests in South Africa.

G. A. P. Moorhead has been made Commissioner of Lands and Mines of British Guiana.

Bryan Roe recently left England to join the staff of Consolidated Tin Mines of Burma, Ltd.

Prof. Walter H. Newhouse, professor of economic geology at M.I.T., has joined the faculty of the University of Chicago as professor of economic geology. He will assume his new duties on Oct. 1 next. Professor Newhouse holds a bachelor of science degree from Pennsylvania State College and a master of science and a doctor of philosophy degree from M.I.T. During the second World War he worked on titanium deposits in Wyoming in addition to his teaching assignments. He is the editor and chief contributor of the book published by National Research Council Committee on "Processes of Ore Deposition."

Dr. Robert S. Williams, head of the department of metallurgy at M.I.T., who acted as deputy dean of engineering during the war, and **Prof. Carle R. Hayward,** professor of process metallurgy in the Institute's Department of Metallurgy, retired on July 1. Dr. Williams, though relieved from active teaching responsibilities, will continue to serve as dean of Army and Navy students, with the rank of professor emeritus and honorary lecturer. He has been associated with M.I.T. for 44 years. He is co-author, with **Prof. V. O. Homerberg,** of "Principles of Metallography." Professor Hayward is an authority on process metallurgy, particularly on copper, lead, and zinc. He was graduated from M.I.T. in 1904 and has been on the Institute faculty since 1906.

L. S. Breckon, long chief geologist for the Utah Copper Co. and directing Western investigations for Kennecott Copper, has been inspecting mine properties in northern and central Nevada.

William Sharp, resident engineer at Eureka for the Eureka Corporation, Ltd., recently spent a month in Mexico on property examinations for Ventures, Ltd., and more recently has examined mine properties in Washington State.

Dr. Thomas T. Read, Vinton professor of mining engineering, Columbia University, who retired on June 30, has been appointed emeritus professor. He will continue as secretary-treasurer of the Mining and Metallurgical Society of America, and has been appointed a consultant of the U. S. Bureau of Mines.

R. F. Goodwin, formerly manager of the mining department of American Smelting & Refining Co., has been elected vice president (in charge of mines) in succession to the late H. A. Guess; he also becomes president of Premier Gold Mining Co., Ltd., and of Silbak Premier Mines, Ltd. **W. H. Loerpabel,** vice president of the Pre-

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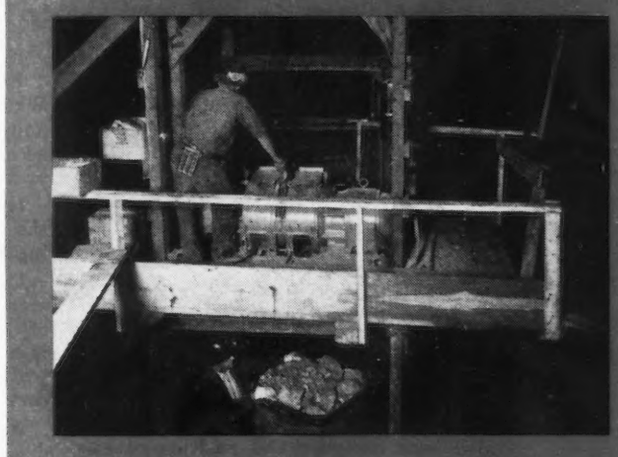

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mier and Silbak Premier companies, has succeeded Mr. Goodwin as manager of the mining department of A.S.&R.

J. M. Turnbull and **George A. Gillies** have been made professors emeriti at the University of British Columbia. Before his retirement last year, Mr. Turnbull was head of the department of mining and metallurgy since its inception in 1915. Mr. Gillies retired last year after being a member of the faculty since 1919 and professor of metallurgy since 1937.

Ralph D. Perry has been named general superintendent of the newly created division of research and development by The Consolidated Mining & Smelting Company of Canada, Ltd.

William M. Armstrong has joined the technical staff of the British Columbia Industrial and Scientific Research Council.

Franc R. Joubin, geologist, has been transferred by Pioneer Gold Mines of B. C., Ltd., to its eastern office and may now be reached at 1110 Concourse Building, Toronto.

B. I. Nesbitt, of the exploration department of The Granby Consolidated Mining, Smelting & Power Co., Ltd., has opened offices as consulting geologist at 305 Royal Bank Building, Vancouver.

Adolph Chanosky, of Fort Worth, Tex., recently visited Little Rock for a conference with state officials regarding the possibilities of ilmenite deposits on land and mineral leases which he owns near Nashville, Howard County, Ark.

James C. Brice, former lieutenant in the U. S. Navy and a graduate of the University of Alabama with a B.S. degree in geology, has joined the staff of the geology department of the Arkansas Resources and Development Commission as assistant geologist. In the fall he will start graduate studies in geology at the University of California.

James A. Marsh, consulting geologist of Salt Lake City, and previously in charge of war mining development in the Salt Lake area for the U.S. Bureau of Mines and before that chief geologist for Utah Copper Co., has been appointed chief geologist for the Union Pacific Railroad, with headquarters in Los Angeles. He will be in charge of mineral matters from Omaha to the Pacific Coast.

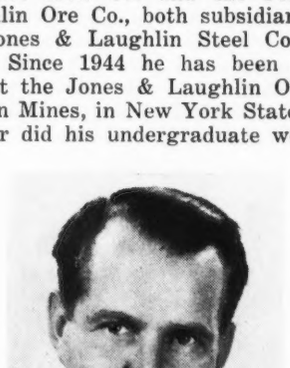
Dr. William B. Mather, formerly principal geologist for the Missouri Geological Survey, Rolla, Mo., has been appointed to the inorganic section of the Midwest Research Institute.

C. Stewart Parsons has been appointed Chief of the Bureau of Mines, Ottawa, Canada. He was Chief of the Metallic Minerals Division of the Bureau since 1936.

R. E. Calhoun, assistant manager of the Tri-State district operations, has also been assigned the position of exploration engineer in the exploration department of the American Zinc, Lead & Smelting Co., Joplin, Mo.

William H. Black, superintendent of mines, has been promoted to the position of assistant general superintendent of the American Zinc Company of Tennessee, Mascot, Tenn. and **M. J. Langley,** assistant superintendent of mines, has been promoted to the position of superintendent of mines.

Dr. W. M. Fiedler has been appointed assistant chief geologist of the Inter-State Iron Co. and the Jones & Laughlin Ore Co., both subsidiaries of the Jones & Laughlin Steel Corporation. Since 1944 he has been geologist at the Jones & Laughlin Ore Co. Benson Mines, in New York State. Dr. Fiedler did his undergraduate work at



DR. W. M. FIEDLER

Carleton College, Minnesota, where he received a bachelor of arts degree in geology. As a graduate student, he attended the California Institute of Technology and the University of California, from which schools he received the degree of master of science and doctor of philosophy, respectively.

A. C. Melting, mining engineer, until recently professionally engaged in Nicaragua, has joined the St. Louis Smelting & Refining organization at Baxter Springs, Kan.

William A. Scheuch has been elected president of Nassau Smelting & Refining Co., succeeding **Frederick W. Willard,** retired.

Chester A. Fulton has gone to the Caroline Islands, on assignment by the U. S. Navy, to rehabilitate the phosphate rock industry there.

Edward H. Rott, until recently with WPB as a deputy director for metals and minerals, has joined the UNRRA as chief of the industrial rehabilitation of Poland.

Irvin Gladstone, geologist, has joined the staff of the U. S. Smelting, Refining & Mining Co.

Colin Yates has returned to his former position of underground manager of Great Boulder Proprietary Gold Mines, Ltd., Kalgoorlie, Western Australia, after several years' military service.

A. Ben Shallit, who has just been discharged from the Navy and who was formerly RFC supervising mining engineer at Joplin, Mo., is now attached to RFC mining office at Fairbanks, Alaska.

Jack W. Clark, formerly of Union Mines & Development Co., Grand Junction, Colo., has accepted a position as geologist with Spectrographic Services & Supplies, Inc., Saratoga Springs, N. Y., and has been assigned to carry out further exploration of the Iron Mountain, New Mexico, beryllium-zinc deposits, prior to coming to the company's laboratory in Saratoga Springs. **Frank Michenfelder,** formerly of the United States Bureau of Mines, College Park, Md., has also joined the staff of the same company as petrographer.

OBITUARIES

John C. Barker, 88, pioneer mine operator, died on June 6 in Great Falls, Mont. Barker came to Montana more than 60 years ago, settling in Butte for ten years. At Neihart he managed the old Ripple mine and had interests in other properties. He was the original locator of the Stillwater chrome mine, now known as Chromium Produce Co.

Arne Lutro, 77, died at Fairbanks, Alaska, on May 1. He was a prominent early day operator on Bonanza and Eldorado creeks, and later in Fairbanks and Ruby.

Ing. Adolfo Garcia Liceaga, 62, who was manager of San Luis Mining Co. and during the government of President Plutarco Elias Calles director of the Government's Department of Mines, died on May 28 in Mexico City.

A. H. Means, geologist, of Salt Lake Ctiy, died on June 15 at Los Angeles, at the age of 56. He was a veteran of both World Wars.

Dr. Ali A. Hassan, internationally known geologist, died on June 7 in East Orange, N. J., in his 87th year. Hassan was born in Constantinople and educated in Vienna. An appreciation of Dr. Hassan's life and achievements will appear in the August issue.

Allan MacKay, past president of the Canadian Institute of Mining and Metallurgy, died recently at Mattawa, Ontario, Canada.

An Appreciation of George Ernest Collins

George Ernest Collins died at Ouray, Colo., on May 4, 1946, as the result of a tragic automobile accident on the afternoon of May 2. He was on a periodic visit to the various mines on Red Mountain with which he was identified for many years, and which recently have been optioned to the American Smelting & Refining Co. At the end of the shift one of the trucks used to convey the miners to Ouray got out of control and rolled over the steep mountainside. There were 14 men in the vehicle, and Mr. Collins was the fifth to die. Most of the others were badly injured.

Mr. Collins was born at Truro, Cornwall, England, on Jan. 18, 1870. He was the fourth son of Joseph Henry Collins,

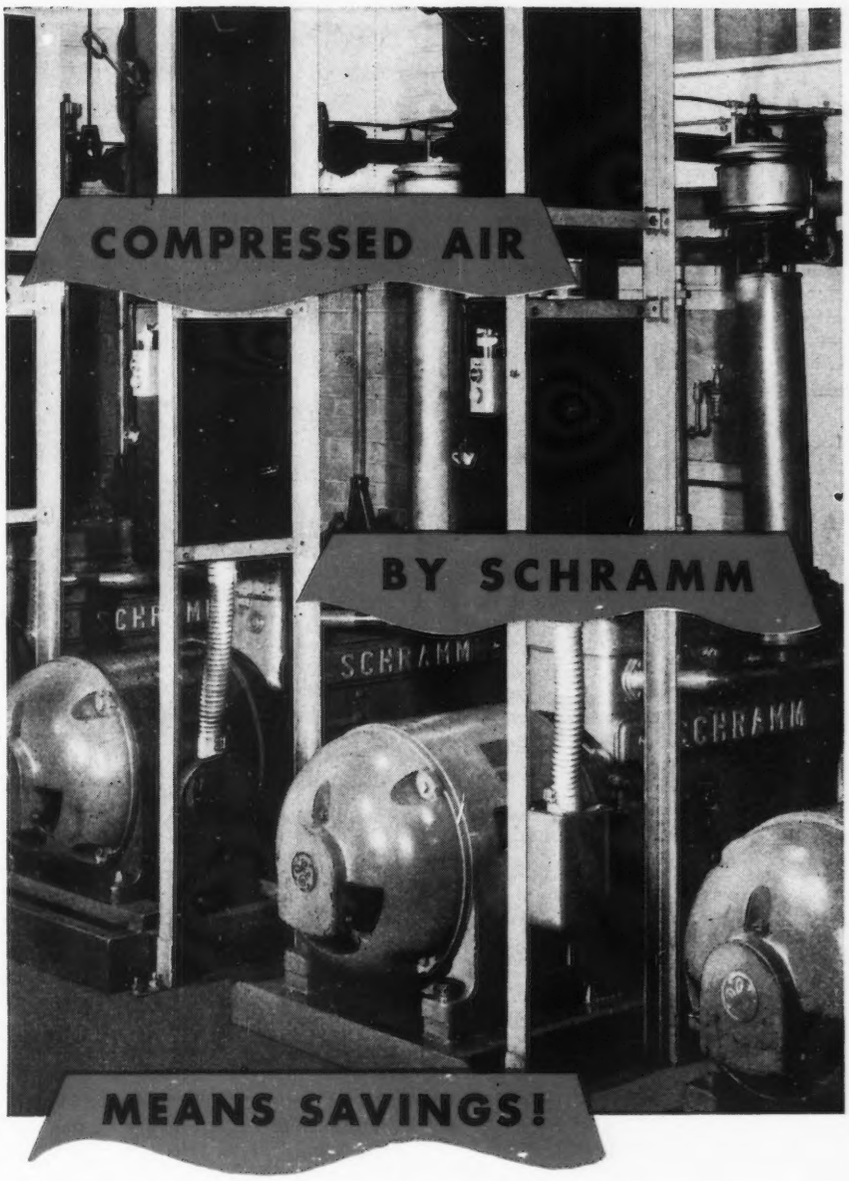
a prominent Cornish mining engineer and geologist. He was the younger brother of Arthur Collins, manager of the well-known Smuggler-Union mine, Telluride, Colo., who in 1902 was assassinated during a strike by some lawless members of the then Western Federation of Miners.

Mr. Collins was educated in private schools and the Finsbury Institute in England, and was professionally trained by serving his apprenticeship under his father. During this period he made a name for himself by achieving a record for low mining costs at the Great Wheel (mine) of Furtune, in Cornwall. He came to America in 1892 to serve as a consultant for some mines in Colorado and Georgia. Since 1902 he maintained an office as consulting engineer in the Boston Building, Denver, Colo. The greater part of his professional work had been in Colorado. He managed various mines in the Central City-Idaho Springs area, and in 1910 the 6-mile Argo (Newhouse) tunnel was completed under his management. For many years he was manager of the Mary Murphy Gold Mining Co. at Romley, Colo. In his long professional career he was active, at one time or another, in virtually every camp in Colorado, and his fund of knowledge of Colorado mines and geology was perhaps unsurpassed by any one associated with the industry.

Mr. Collins was always interested in new developments. He played a prominent role in the introduction and adaptation of rock drills to mining. He invented and developed improved methods of applying steel sets to replace timbering in tunnels and drifts. He was a pioneer in fostering both flotation and electro-static separation at the Mary Murphy mine, whose ores were very complex. In addition to his keen interest to technologic developments, he was catholic in his other activities. He contributed numerous articles to the various technical journals and to publications of the societies with which he was affiliated. He had been a member of the A.I.M.E. since 1900. He was a member and chairman of the committee on professional conduct of the Mining and Metallurgical Society of America, an ex-president of the Colorado Scientific Society, an ex-governor of the Colorado Branch of the American Mining Congress, and a member of the Institution of Mining and Metallurgy of London. He was a life member of the Denver Club, a Rotarian, and a Mason.

Mr. Collins was a naturalized American citizen. His wife, née Annie Elizabeth Gwendolen Sharpe, whom he married in London in 1889, died April 23, 1945. His son, Col. A. E. G. Gerald, who survives him, is with the British Air Ministry and lives at Bromley, Kent, England. Mr. Collins was of a reserved and kindly nature. Those fortunate enough to have won his friendship will always remember his fortitude, faith, persistency, patience, loyalty, keen intelligence, and sterling qualities.

C. ERB WUENSCH
San Francisco, Calif.



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Incentive Wage Is Solution To Labor-Management Impasse

The Editor:

By now it should be apparent that raising wages is not the answer to the wage-price problem. Rising prices must necessarily follow unless the increased wages are reflected in additional productivity. This brings the same old issues to a head again, with still more strikes. The important thing to the man who brings home a pay envelope is not how many dollars it contains, but how much the wages will buy. Labor should have learned by this time that there are no benefits for it in an inflationary spiral.

The answer, then, is not simply to give the worker more dollars, which buy less, but to extend to him the same incentives his employer has enjoyed—*incentives to produce more at a lower cost.* Management incentives have produced our great industrial plant, now partly idle. Carefully designed and properly applied labor incentives will put that plant to work again.

Profit sharing is one of the more obvious remedies. It is not a new idea and has long been advocated by labor. It may emerge from the present turmoil as a solution to be forced on labor by its leaders and on business by well-meaning but misguided reformers. Direct profit sharing will benefit labor only slightly more than wage increases. Though profit sharing will bring some increase in production, it will not be such an increase as should be secured from a well-designed incentive pay plan.

The best way the worker can participate in the profits is to share in the increased profit which he himself is capable of creating. The most practical method by which this can be done is through an incentive wage plan. Many large organizations now have incentive plans in operation, but the practice is by no means general.

The best type of incentive plan is one in which the worker participates on an individual basis and the amount of incentive pay he receives, in addition to his hourly wage, is based directly on the amount he produces. A standard time is set for each unit of work by means of time studies taken by a qualified industrial engineer or by an analysis of motion pictures. At a certain rate of production—that is, a certain number of units per hour or day—the worker will be at the "break-even" point at which he is producing enough to justify his hourly wage but not enough to earn incentive pay. If he falls below that point his hourly wage is not affected. However, if he exceeds the break-even point he receives a bonus equivalent to a fixed percent of the labor cost of the additional work produced.

Company policies in regard to incentive bonuses should be fair and the establishment and maintenance of the plan must be thorough. The incentive earnings of each person should be calculated daily and a report of these earnings posted in the shop. Incentive payments should be paid at the same time as hourly wage payments. All standards should be guaranteed once they are set. In no case should management cut a time standard unless there is a change in equipment, materials, or working conditions that affect the job. The standards should be set so the average worker can be expected to earn a reasonable amount each day in incentive pay without overtaxing himself or injuring his health. If there is any complaint about a particular standard being too difficult to meet, the industrial engineer in charge should make new studies of the job and either change the standard, if the complaint is justified, or show the worker what he is doing wrong that prevents him from meeting it. The workers themselves or their representatives should be allowed to check incentive records. The standards as set should not be subject to arbitration, as they are determined scientifically, but it should be possible for any time-study man employed by the unions to check the rates.

It is desirable, also, to base incentive pay on other factors than units of production alone. Where high-quality work is desired, where savings in fuel, expensive material, or other costs can be measured, an incentive bonus can be applied. Even indirect labor and some elements of overhead can be brought under an incentive plan. Foremen would be entitled to participate on the basis of the average percent of incentive bonus earned in their departments. In few cases are there industrial jobs for which it is impossible to develop a basis for incentive pay.

The benefits of an incentive pay plan, particularly if applied on a national basis, extend to three groups: the worker, the employer, and the public.

The worker benefits not only from higher pay, but, when production is increased, from a lowered cost of living—an actual increase in real wages and in the goods and services a day's work will purchase. He becomes to a greater extent the master of his own fate. The only limitations to what he can earn are his own ability and his will to work. He can take pride in his work and develop a spirit of competition with his fellow workers which adds interest to the old routine of his job.

The employer gains by a reduction of the unit cost of direct labor. Equally important is reduction in overhead and indirect labor cost per unit of production. A properly applied incentive plan also provides means of analyzing and controlling costs, of measuring performance, and forecasting results, all of which make greater savings possible.

The public benefits by reduction in the cost of living with rising standards of living and relief from the dangers of inflation. Full production will mean full employment, industrial prosperity, and international security.

Progressive labor leaders are now aware that a high rate of production at good pay is labor's most ideal condition. Most workers, when shown it is to their interest, would prefer to do an honest day's work rather than to loaf on the job. Loafing is far more tiring and less satisfactory than a job well done for good pay. When shop conditions are as they should be, the men take pride in their work, are jealous of their ability, and have a genuine feeling of self-respect.

Good management, too, has progressed beyond the days of the "speed-up" and rate cutting. Men responsible for operation of industrial plants now realize it is poor judgment to drive a worker beyond his capacity, for then his efficiency decreases and his total output of satisfactory production declines. Such incidents create ill feeling and must be avoided, for only in a spirit of cooperation and mutual trust can a successful incentive pay plan be carried out.

To this end, the training, ability, experience, and good judgment of the industrial engineer become of paramount importance. He must represent not only the interests of management but also must see that the worker gets a square deal. His job is not an easy one and requires the utmost tact. Not only must the worker receive increased wages for increased output, but there must also be an increased profit to the company. This requires the greatest care in establishment of standards and their maintenance. The principles of industrial engineering have made this accomplishment possible, and it is to these principles we must look for a solution of our problem.

When the incentive wage principle is adopted by all large employers on a national basis, and accepted and encouraged by labor, we will have found the answer to our present labor-management difficulties. The ending of this struggle, together with the benefits to be gained from incentive wages, will promote increased production, higher wages, lower prices, happy labor relations, and an economy of plenty. And, to this should be added the vital factor of national security.

WILLIAM C. SPENCER,
Oakland, Calif.

A New Frontier for Young Ex-Service Men

The Editor:

I was much interested in Mr. Just's article "Is the Mining Industry Neglecting Its Young Men," in the December 1945 number of *Engineering and Mining Journal.* This article starts with the heading "Give the Young Fellows a Better Break."

The discussion is timely, because millions of young Army and Navy personnel have been and still are being demobilized. While in Tokyo on a special

(*Continued on page* 142)

IT'S STILL THE OLD RELIABLE

Years ago, on some job or other, Bethlehem Hollow was dubbed the "old reliable" drill steel.

That term has been used so much, in connection with Bethlehem Hollow, that it no longer has any originality.

Nevertheless, it's just as appropriate today as it was many years ago.

For Bethlehem Hollow is a truly reliable drill steel. Your blacksmith knows that it's uniform; makes up easily; gives him no trouble in the heat-treating stage. It can be safely hardened over a broad quenching range, and it is tough and fatigue-resistant.

It is as good for threaded rods as it is for forged-on bits. The hole is always smooth, round, and well centered—a feature that both your blacksmith and your drill runners like.

These points mean dependability. When you purchase Bethlehem Hollow, you are *getting* true dependability—and paying nothing extra.

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SURE — WHEN IT'S A GOOD HORSE, YOU GIVE HIM A LONG RIDE.

BETHLEHEM HOLLOW DRILL STEEL

★ BETHLEHEM STEEL ★

REGIONAL NEWS

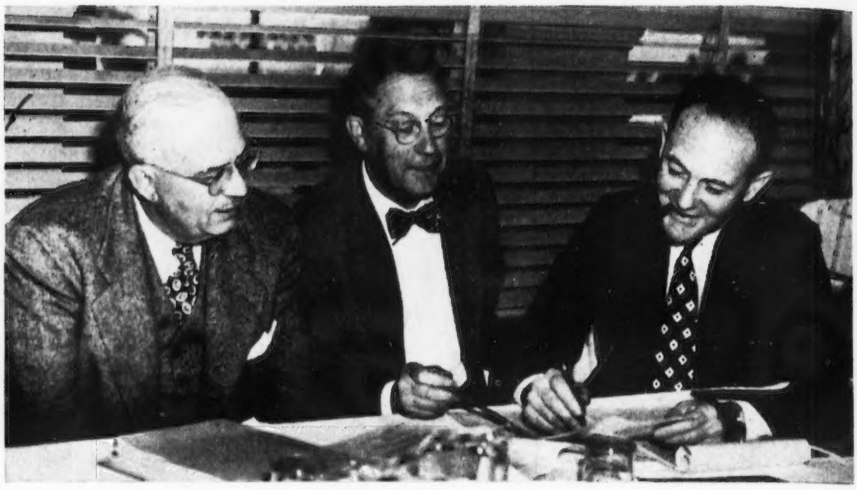
COLORADO

Veta Mining Co. driving three-mile tunnel—A.S. & R. opens new ore in Garbutt shaft

★Plans for the Metal Mining Convention and Exposition of the Western Division of the American Mining Congress were formulated at a meeting in Denver on June 12, attended by Secretary Julian D. Conover of the Congress; J. B. Haffner, general manager of the Bunker Hill & Sullivan Mining & Concentrating Co., Kellogg, Idaho, chairman of the program committee; and Merrill E. Shoup, president of Golden Cycle Corporation and chairman of the Western Division. Robert S. Palmer, secretary of the Colorado Mining Association, Denver, will cooperate. The convention and exposition will be held in Denver Sept. 9 to 12, and more than 2,000 mining men and mining equipment manufacturers will attend. The convention will feature displays of equipment for the first time since 1941, and about 17,000 sq. ft. of the Denver Auditorium will be set aside for the exhibits. The equipment exposition is sponsored by the Manufacturers' Division, of which Robert H. Pearson, vice president of Gardner-Denver Co., Quincy, Ill., is chairman

★The U. S. Bureau of Mines has begun a comprehensive investigation of shafts in the Leadville area, under direction of Norman D. Ebbley, district engineer for the Bureau. A portable hoisting unit has been built at the Bureau's shop. It is mounted on a four-wheel-drive truck, and utilizes a bucket suspended from a boom projecting from the rear of the truck. The unit has a capacity of 3,000 lb. and will handle 1,150 ft. of ½-in. cable. Some dozen of the old shafts have been marked for investigation, and Mr. Ebbley has also signified his readiness to investigate others at the request of the owners. All workings accessible from the main shafts will be mapped geologically and all ores will be sampled.

This work is part of the Leadville ores investigation, which also includes some diamond drilling, particularly for manganese, on Fairview Hill, east of the city. Samples, whether obtained from shafts or by diamond-drilling, are being sent to the Salt Lake City metallurgical laboratory for analysis and study to determine possible methods of successful and economical treatment of the complex Leadville ores. Chief interest, Mr. Ebbley said, is in lead carbonates, zinc, and lead sulphides, and zinc carbonates and oxides.



CONFERRING IN DENVER, COLO., on June 12 to map plans for the 1946 Metal Mining Convention and Exposition of the Western Division of the American Mining Congress to be held in Denver Sept. 9 to 12 are, left to right: Merrill E. Shoup, president of Golden Cycle Corporation and head of the Western Division, American Mining Congress; J. B. Haffner, general manager of Bunker Hill & Sullivan Mining & Concentrating Co. and chairman of the program committee; and Julian Conover, secretary of the American Mining Congress.

★The Matchless mine, opened by the famous old Tabor shaft, at Leadville, is again being developed. Tom Nixon and Gus Ingensen, of Denver, have leased it and have a four-man crew at work. A shop has been constructed and a one-ton hoist has been installed.

The Matchless retains its hold on tourists. About 500 persons signed the visitors' register last summer, despite the ban on travel. Tourists from many states have already visited it this summer.

★The purchase of 200 additional acres of mining land by Resurrection Mining Co., which has been embarked on an expansion program at Leadville, is reported. Several well-known mines are included. The purchase is in the Iron Hill and Carbonate district.

★Dr. E. R. Fredette, Jules Verfaille, Sam E. Wright, and Thomas H. Wright have organized a company which has taken over the Brooklyn group of claims, near Blackhawk. E. G. Fye, Jr., is the engineer in charge. A mile of new road has been constructed to a new portal, and buildings are being constructed. A new tunnel, to be driven 1,500 ft. this summer, will cut through several recognized veins.

★The Williams mine, at the head of Virginia Canyon, has been leased to H. L. Hunt, of Dallas, Tex., an independent oil operator. John Wilcox is in charge of mine operations. It is owned, and was operated before the war, by J. H. Young, of Centerville, Iowa, and Ed Westwood, of Idaho Springs.

★The Malachite mine, on Genesee Mountain, has been reopened by R. G. Moore, of Idaho Springs. The mine is a copper producer, with some gold and silver values. Seven men are employed. J. B. Fuerstenberg, of Denver, operated here before the war.

★One of the famous old landmarks of western mining is to be obliterated. This is the original prospect hole reputedly marking the spot where Bob Womack, of Cripple Creek, in 1891 discovered the first gold in the camp. A new highway will cross directly over the site of the old prospect hole.

★Glenn Ferman and Gerald Anderson, of Victor, have leased the Acacia and Free Coinage properties, on Bull Hill, in the Cripple Creek district, from the Acacia Mining Co., of which Albert Mackenzie is president. They plan to mine through the South Burns shaft, and are installing a new electric hoist, new cable, compressor, and other equipment. Six men are employed on the operation.

★Le Clair Consolidated Mines Co. is starting a program of exploration and development work in the Howard mine, at Cripple Creek, which is being carried on through the Morning Glory shaft, on Raven Hill. C. H. Carlton, Jr., is in charge.

★At Telluride, the Veta Mining Co., managed by Harold Worcester, is driving a three-mile tunnel that will cut the Pandora, Union, Bullion, and Smuggler veins and then raise to the Montana. The company has already

driven more than 500 ft. The tunnel is 9x9 ft.

★The Civilian Production Administration has approved application of the New Jersey Zinc Co.'s mine at Gilman, Colo., for a new $20,000 office building.

★The Bureau of Mines has completed and occupied the office building on the site of its experimental oil shale mine 8 miles west of Rifle. The building cost $46,000. A large machine shop and warehouse and a combined carpenter and electrical shop and garage have also been built. Foundations have been laid for the chemistry laboratory, boiler plant, and the first retort unit. Fifty housing units are being installed. These are of the temporary, prefabricated types, and are mostly being brought from Cunningham, Kan., where a helium plant was operated by the Bureau during the war.

★American Smelting & Refining Co. has discovered a wide vein of good-quality lead-zinc ore in the Garbutt shaft, at Leadville, which the company took over last winter, cleaned out, and explored by means of diamond drilling. An electric hoist has been installed. The vein is reported to run about 13 ft. wide of milling-grade lead-zinc ore. "Encouraging, but no bonanaza," states Sergei Zelenkov, in charge of the Garbutt operations.

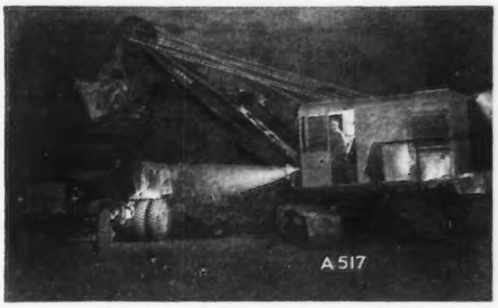
★J. N. Thouvenell, operating under the name of Federal Mining Co., owner of many claims in Russell Gulch and the Nevadaville district around Virginia Canyon between Idaho Springs and Central City, has encountered something rare in the Russell shaft, which he was developing. This is saturated talc in a chimney-like or crater-like formation, which oozed past the timbering and into the shaft. The talc itself carried values, and in it were large chunks of ore, Mr. Thouvenell said. Because of the danger to the miners, he abandoned direct attack on the shaft and is approaching through a crosscut from the 400-ft. level of the Federal shaft. Here he hopes to find that the talc chimney has been plugged by solid roof or ore from the protection of which it can be developed. Federal Mining Co. is building a mill to serve the many claims it owns.

★Settlement of the smelter strike put about 300 men back to work at the Arkansas Valley smelter of American Smelting & Refining Co., and about 100 at its Globeville smelter, near Denver, a major producer of cadmium. However, one angle of the strike remains to be straightened out in court. When the Colorado Industrial Commission ruled that the company's Leadville employees, including those laid off early in February, were all on strike and therefore not entitled to unemployment compensation beyond April 5, the men had already received unemployment checks for the period up to May 5. The state is demanding return of the money for the month—averaging $75—

Underground Mining Demands Manganese Steel Buckets . . . . .

In tunneling and the removal of ore or rock, the equipment that handles the material receives incessant abuse — repeated impacts and severe abrasive wear.

Amsco dippers, buckets, scrapers and wearing parts have been made for every kind of mining and quarrying operation. You will find them on many rugged jobs where continuous pounding, heavy loads and abrasion would quickly destroy ordinary buckets. Amsco design has added substantially to the economy of the metal and the operating efficiency of this class of equipment. These designs make provision for the easy replacement of the parts which require it sooner or later. The use of manganese steel assures "a long time between replacements."



A-517. 2 yd. Amsco all-manganese-steel welded type dipper on Lorain 82 shovel loading blasted limestone in underground quarry.

This kind of service naturally calls for manganese steel dippers, buckets or scrapers, as no other stands up so long under the drastic punishment. Here continuous operation is important, and out time for equipment repairs cuts sharply into output and profits.

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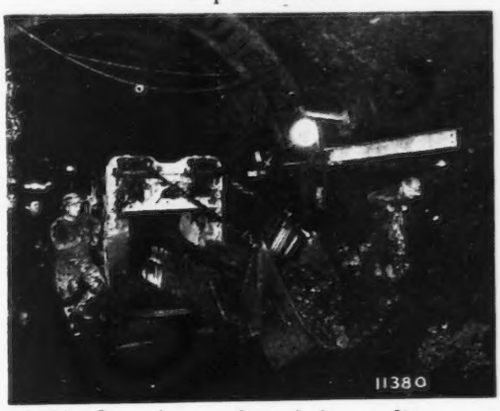
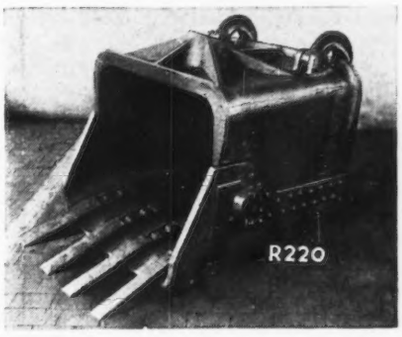


11380. One of a number of Amsco dippers on Conway mucking shovels which speeded work on the Delaware aqueduct.

Send for Bulletin 743-M, "Manganese Steel for Mining and Quarrying Equipment."

Joliette Steel Limited, Joliette, Quebec, owned by American Brake Shoe Company, produces and sells Amsco Manganese Steel Castings in Canada.



5/8 yd. Amsco Missabe type dipper with Vanderhoef front, used in a Newfoundland submarine iron ore mine.

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Colorado *(continued)*

and the union has appealed the case to the Colorado Supreme Court.

★Operations are being resumed at the Sandiago tunnel of the Treasure Mountain Gold Mining Co., near Silverton, under the direction of E. R. Abadie. Among the 32 patented claims which the company owns on Treasure Mountain, about 11 miles north of Silverton, are three early-day producers of gold and silver: the Golden Fleece, the Scotia, and the San Juan Queen. These mines are to be further developed through the Sandiago tunnel. The property has been closed down for several years because of Order L-208.

★Colorado Feldspar Co., a subsidiary of Consolidated Feldspar Corporation, of Trenton, N. J., has obtained priorities totaling $150,000 through CPA in Denver for the building of a large feldspar processing mill at Parkdale, 12 miles west of Canon City, where the company owns considerable feldspar deposits.

UTAH

Five months' old strike settled by 18½c. wage increase—Operations resume slowly

★Utah's five-month mine and smelter strike was settled tentatively June 17 when the 60-member policy committee of District 2, International Union of Mine, Mill & Smelter Workers, CIO, voted 59 to 1 to ratify an agreement worked out with management, both aided by Robert C. Williams, special U. S. Labor Department conciliator for the non-ferrous metals industry, who had been in Salt Lake City since May 13.

The following day, officials of the three major companies, Utah Copper Co., American Smelting & Refining Co., and United States Smelting, Refining & Mining Co., met with union representatives to plan resumption of operations, and by midnight of the same day local unions had ratified the contract agreement.

All three companies planned to resume operations at first on a nominal basis. These were to be on a 40-hour, five-day week, although prior to Jan. 21, when the strike began, all three were on a 48-hour, six-day week. The companies reserved the right to operate on a 48-hour week if conditions should warrant this.

Details of the agreement include:

1. Over-all wage increases of 18½c. per hour for all hourly rated men; $32 per month increase for clerical and technical workers at Garfield; and 18½c. per hour for clerical and technical workers at the Arthur-Magna mills of Utah Copper Co.

2. For hourly rated men, 9¼c. retroactive to Sept. 1, 1945; for clerical workers of Utah Copper and AS&R, $16 per month retroactive to the same date.

3. Standard maintenance of membership clause with escape period from Sept. 1, 1946, to Sept. 15, 1946, inclusive. Present maintenance of membership clause in AS&R and Utah Copper contracts to be effective until escape period. USSR&M to apply similar maintenance of membership clause. Union to give written notice of men not in good standing.

4. Vacation privileges not to be impaired by strike. All employees to work four weeks before taking vacations or requesting vacation pay in lieu of vacation time.

5. All workers, upon termination of strike, to be recalled to work as soon as plant operations permit, and be allowed a period not to exceed 15 days in which to report, except for some bona fide reason, such as illness. To be eligible for retroactive pay a worker must comply with requirements of this paragraph and must in addition complete a minimum of ten days' work thereafter.

6. All employees, upon termination of strike, to be returned to work by companies without discrimination as soon as plant operations permit. Union agrees not to use maintenance of membership clause or any other security provision of contract against any employee because of any act done or omitted by such employee during the strike.

7. All unpaid charges for rent and lights accrued during the strike for employees living in company houses are to be paid in full, but may be prorated over a twelve-month period. Such debts may, however, be deducted in full from wages upon termination of employment.

8. Common labor rate remains at $6.45 per day, but Utah Copper Co. agrees to increase rates at the open-pit mine from $6.15 to $6.45, and from $6.35 to $6.65. Company is to make all increases due to reclassification retroactive to Sept. 1, 1945.

9. Contracts shall cover period July 1, 1946, through June 30, 1948, inclusive. Either party may reopen on wage rates by giving notice between June 1 and June 30, 1947, inclusive.

★Iron ore output of Utah mines increased from 26,877 gross tons in February to 55,078 in March, the U. S. Bureau of Mines reported.

★Of approximately 5,000 Utah mine, mill, and smelter workers who went on strike Jan. 21, more than 2,000 found temporary employment, Charles R. Brooks, publicity chairman for District No. 2, International Union of Mine, Mill and Smelter Workers, said late in May. He reported that approximately 1,000 families were being cared for by the union's relief committee.

★New Park Mining Co. stock was approved by the board of governors of the New York Curb Exchange on June 5 for listing and for admission to deal-

ings at a subsequent date. The company listed 2,989,000 shares of outstanding $1 par capital stock. The shares have been traded on the Salt Lake City Stock Exchange since July, 1937. The company, incorporated in Nevada in 1932, has been in production since 1940. It ships gold, zinc, lead, silver, and copper ores to the U. S. Smelting, Mining & Refining Co. plant at Midvale, Utah.

★Douglas C. Despain, veteran miner and leaser who was superintendent of the Park City Consolidated mine during its development and early production, now is superintendent in charge of operations for Big Cottonwood properties of Mountain Mines Co., C. S. Woodward, president, reports. Development in progress includes driving of 500 ft. on the Silver King vein and 200 ft. on the Waterfall vein to explore downward extensions of oreshoots opened at 17 upper levels over a period of years. The company in recent years has driven a transportation tunnel about 4,000 ft. and other workings 1,400 ft., making shipments of 70 carloads of ore.

★Assessed valuation of Utah mines and utilities has been reduced by the State Tax Commission from $279,061,421 in 1945 to $260,535,331. A major decrease was Utah Copper Co., on which the net proceeds figure is fixed by formula at $66,296,639, compared with $86,088,418 for 1945.

MONTANA

Bureau of Mines explores Minah and Durand properties — East Helena smelter strike ends

★An exploratory program is being conducted by the U. S. Bureau of Mines at the Minah mine, in Jefferson County. The Bureau has completed an extensive program of bulldozing, surface trenching, mapping and geological investigation and is about to begin diamond-drilling operations. Several holes will be drilled in an effort to intersect mineralized veins at depth. The Minah mine was formerly an important producer of lead and silver. Robert D. O'Brien is project engineer and is in charge of the exploratory program.

★The Durand mine, about 8 miles south of Jens, is also being investigated by the Bureau of Mines. The Bureau is exploring the surface and underground workings. A bulldozer is employed to remove overburden in the search for vein outcrops. O. J. Durand is owner of the property, which has been a producer of lead, zinc, and silver. Don Hoiekvam is the engineer in charge of the project.

★E. McL. Tittmann, manager of the East Helena smelter of the American Smelting & Refining Co., has announced the signing of an agreement in Washington by AS&R officials and

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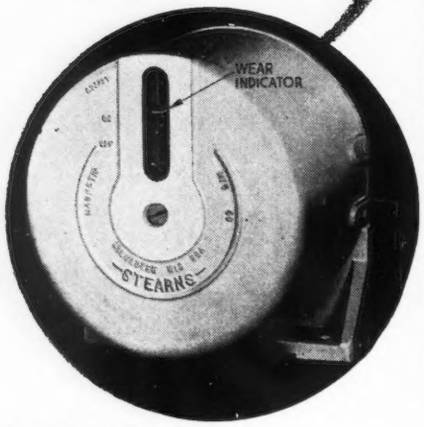

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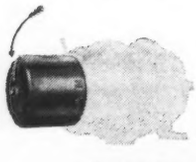

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Montana *(continued)*

the CIO affiliated union which provides for an end to the strikes in the company's 18 plants. The strike, which started Feb. 25, has virtually paralyzed lead mining in western Montana.

"Though we do not yet have the details of the agreement reached in Washington, I understand that the wage increases and the effective date have been agreed upon and that there is no other issue to prevent signing of a local contract," Manager Tittmann said.

"As soon as the contract is signed, work will be started to put the plant in condition for operation. This probably will take a week to ten days."

The manager said all of the 200 idle men at the East Helena smelter will be returned to work as quickly as possible. He said one furnace, employing 175 men, probably would be in operation within a week, and that the plant's second furnace would be put in operation soon.

Morris Munding, president of the East Helena local, Mine, Mill and Smelter Workers' Union, said the men were ready to go back to work as soon as a local contract is signed.

★Julius A. Krug, Secretary of the Interior, delivered the commencement address to the 46th annual graduating class of the Butte School of Mines. The cabinet official outlined to ten graduating students some of the problems now facing the mineral industry.

"The chances of making bonanza discoveries," Secretary Krug warned, "are small. The potential mineral areas of the United States have been extensively prospected, and it is reasonably safe to assume that most of the high-quality surface deposits, or those whose presence is indicated by outcrops, have already been found." He advised application of improved technology to deposits now known, as has been done to develop some large mining prospects. The Cabinet officer, who prior to his recent appointment was chairman of the War Production Board, said: "We should stockpile scarce materials—that is, we should import emergency supplies of metals that are scarce here, and store them, and we should add to that reserve our own surpluses whenever we produce metals in greater quantity than we use them. We should intensify our explorations for new reserves. Improved instruments and methods would make our explorations effective and relatively cheap. A happy-go-lucky belief that there is plenty more to be discovered is not good enough, even though the measurement of resources is necessarily somewhat vague around the edges."

Mr. Krug received an honorary degree of doctor of engineering from Dr. Francis A. Thompson, president of the School of Mines. While in Butte the Secretary conferred with Governor Sam C. Ford, D. M. Kelly, vice president of Western operations of Anaconda Copper Mining Co.; George Bennett, supervising engineer, U. S. Bureau of Mines; Carl J. Trauerman, manager of the Mining Association of Montana; G. T. Vandel, president of the Last Chance Gulch Mining Association; Lyman Brooks, Jr., president of Irma Mines, Inc.; and many other prominent Montana mining men.

IDAHO

American Silver holdings to be tested at depth—Silver Giant plans 1,000-ft. shaft

★According to sworn statements filed with the County Assessor of Shoshone County, the mines of the Coeur d'Alene district produced in 1945 assessable net profits of $5,029,532, compared with $6,679,751 in 1944. The lower profit margin is due entirely to short labor and other unfavorable operating conditions.

★The mining companies of the Coeur d'Alene district and the local miners' union groups have settled their wage dispute with a raise of 18½c. per hour, based on a 40-hour week. The settlement has been approved by the National Labor Relations Board.

Following is a comparison table between the old and new wage scales:

	Old Scale	New Scale
Miners	$8.25	$ 9.73
Shovelers	7.75	9.23
Timbermen	8.75	10.23
Timber helpers	8.00	9.48
Machinists	9.00	10.48
Machinist helpers	8.00	9.48
Carmen, trammers	7.75	9.23
Motormen (main line)	8.50	9.98
Motormen (mine level)	7.75	9.23
Motormen helpers	8.00	9.48
Main hoistmen	9.50	10.98
Small hoistmen	8.75	10.23
Nippers	8.25	9.73
Shaftmen	9.25	10.73
Pumpmen	8.50	9.98
Compressor men	8.50	9.98
Surface laborers	7.50	8.98
Ore loaders	8.25	9.73
Ore sorters	7.50	8.98
Cagers	8.50	9.98
Trackmen	8.25	9.73
Shift Bosses	9.75	11.23
Blacksmiths	9.00	10.48
Blacksmith helpers	8.00	9.48
Electricians	9.00	10.48
Flotation operators	8.50	9.98
Mill repair men	8.50	9.98
Repairman helpers	8.00	9.48
Carpenters, painters	9.00	10.48

The new agreement supersedes a provisional settlement reached in April by which employees were to receive 75c. per day increase, effective until announcement of the Federal fact-finding board's decisions.

★Sunshine Mining Co. has declared its second quarterly dividend of 10c. per share, totaling $148,882, payable July 1 to stock of record June 1. This brings Sunshine's dividends to $297,764 for the current year and the grand total to date to $25,434,063. The company has removed the concrete dams constructed on the 3,100 level to control a recent mine fire and is now going ahead with deep development work on the 3,100 and 3,700 levels. This work con-

sists of crosscutting virgin ground in the Metropolitan area, drifting on the Sunshine Consolidated orebody on the 3,100 level, and exploring the recently discovered, silver-lead orebody in Silver Syndicate ground. The last-named orebody shows a width of from a few inches up to 12 ft., averaging about 4 ft. for the length of more than 200 ft. so far opened, and assays an average of 47 oz. silver and 22 percent lead per ton, according to R. D. Leisk, Sunshine manager.

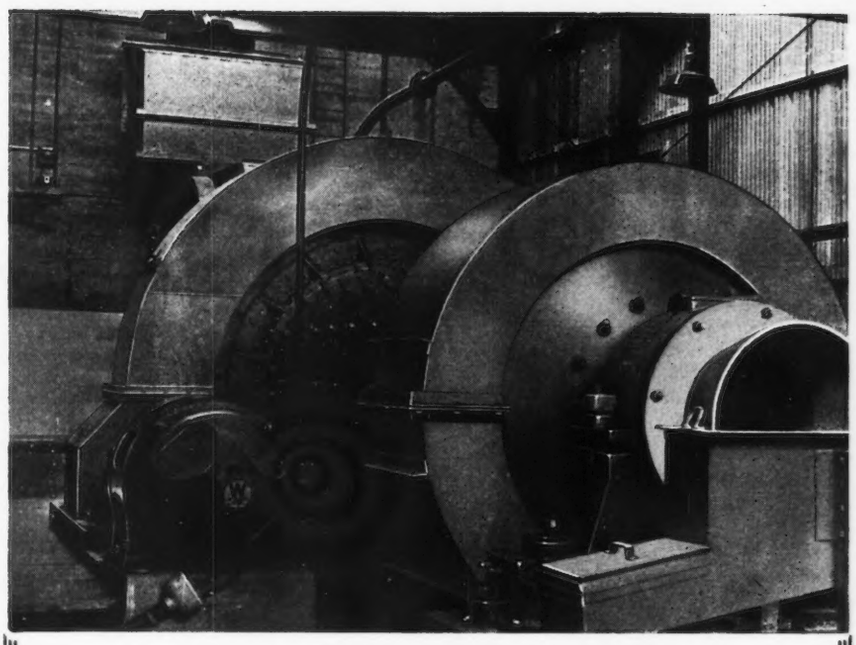
★Callahan Consolidated Mining Co. reports a net profit of $18,000 from mining and milling operations so far this year. The company recently opened a new orebody on the 300-ft. level of the old Rex mine, which has an average width of from 10 to 12 ft. of good average grade ore containing zinc and lead.

★Crescent Pacific Mining Co. is starting one of the largest dredging operations ever undertaken on the Salmon River. The company has leased from the State a block of ground stretching for 9 miles along the river from Lucile, Idaho, and is installing a dredge which it is estimated will handle 1,500 cu. yds. of gravel daily.

★The Coeur d'Alenes Mines Corporation and the American Silver Mining Co. have entered into an agreement whereby Coeur d'Alene Mines will prospect American Silver ground from the 2,800-ft. level when the present shaft, now under way, reaches that level. Under the agreement the two companies will share 50-50 in net profits from ore developments on American Silver ground. The American Silver holdings consist of 15 mining claims adjoining the Coeur d'Alene Mines on the south and are undeveloped except for surface prospecting. Coeur d'Alene Mines has three separate veins in its own ground, one of which was productive down to the 1,800 level, where it lost its silver values. The present shaft development will open the vein 1,000 ft. deeper, where a return of the silver values is expected. The two other veins, the Commodore Truxon and an unnamed vein, are unexplored except for a crosscut to the Commodore Truxon on the 1,400 level. This crosscut shows a promising vein of lead-silver ore.

★Silver Giant Mining Co. is making preparations to sink a shaft to a depth of 1,000 ft. on a group of mining claims about three miles south of the Sunshine and Metropolitan mines in the Big Creek area, and is building a 13,000-volt electric line, branching from the Washington Water Power system at the Metropolitan workings. The collar of the proposed shaft will be 1,100 ft. underground. Silver Giant holdings are under lease and bond from the Silver Bowl Mining Co.

★Lynch-Pine Creek Mining Co. has cancelled all custom milling contracts at the company's Amy Matchless mill, on Pine Creek, and announces that hereafter it will mill only its own ores, which will take the full capacity of the plant. The company has recently added



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Idaho *(continued)*

a 400-ton sink-and-float unit to its milling facilities.

★Verne Clayton and associates, of Boise, are reopening the old Gambrinus gold mine, in the Boise Basin country, 7 miles northeast of Idaho City. The mine is said to have produced gold ore in the early days of Boise Basin.

★The Coeur d'Alene district now possesses 34 modern flotation type concentrating mills, having a combined treatment capacity of 15,000 tons of ore per day. At present there is not an idle mill in the district. Custom mills are choked to capacity, with stockpiles of ore stacked in the yards awaiting treatment. Because of labor conditions and tonnage "quota" requirements, some of the big mills of the district are operating at about half capacity, a condition which has prevailed since price ceilings were imposed.

★Development operations at the Sunshine Consolidated property are to be resumed immediately, according to an announcement by the company. The work will start from the 3,100 level, where the Yankee Girl vein has been drifted on for a distance of 600 ft., with the last 200 ft. in ore of good milling grade. In this drift work 500 tons of ore were produced and milled in the Sunshine plant, averaging 20 oz. silver per ton. The work is being done by Sunshine Mining Co., which has recently purchased a half interest in Sunshine Consolidated.

★Hecla Mining Co. has declared its second quarterly dividend of 25c. a share for 1946, totaling $250,000. This brings the Hecla dividend record to $500,000 for the current year and to a grand total of $29,405,000.

★Mineral Exploration & Research, Inc., a mining concern capitalized at $500,000, and headed by Yakima, Wash., business men, will begin work late this summer on its gold and silver property on the South Fork of the Clearwater River, 45 miles east of Grangeville, according to Harold F. Pearl, president of the company. He says the company is installing $300,000 worth of new equipment in the mine, which has been abandoned since World War I.

NEVADA

Anaconda proves large copper deposit near Yerington—Eureka shaft nears 1,000-ft. point

★Anaconda Copper Mining Co. reports acquisition of title to all claims embraced in the Copper Flat and adjoining areas from one mile to three miles west of Yerington, Lyon County, and near the formerly productive Mason Valley copper mines. The property acquired, including the Guild - Adams groups, had been tested by drilling and shaft sinking during two years by the International Smelting & Refining Co., Anaconda subsidiary, and results were said to indicate one of the largest copper deposits in the country. The Anaconda report estimates proved ore at 50,000,000 tons with content of 1.02 percent copper.

★Getchell Mine, Inc., foremost Nevada gold producer before the war, with late additions of equipment and improvements in metallurgy will be able to treat around 1,500 tons per day upon resumption of milling, but the cyanide plant remains idle because of labor shortage. A new three-compartment shaft, 3,000 ft. north of the open-cut and tunnel workings, is being sunk to cut the ore zone at 1,200 ft. on its east dip, and a crosscut is being driven to the vein on the 300-ft. level 600 ft. below its towering outcrop. The tungsten concentrator, housed in the cyanide mill structure, has been treating 600 tons of scheelite per day from nearby Metals Reserve Co. stockpiles.

★Consolidated Coppermines Corporation, of Kimberly, reports income before charges for the first quarter of 1946 was $169,196.77, against $287,399.14 for the first quarter of 1945. Net income for the 1946 quarter before depletion was $63,374.54, compared with $128,676.50 for last year's first quarter. The figures, said John A. Payne, president, are subject to year-end audit.

★Combined Metals Reduction Co., with a 400-ton selective flotation mill near Pioche, in 1945 produced concentrate and direct-smelting lead-zinc-silver ore yielding $2,665,235.25, Secretary O. F. Burton reported. Costs aggregating $1,572,028 left net earnings of $1,040,637. Formerly 90 percent owned by National Lead Co., Combined Metals was reorganized last year, when control was said to have been acquired by a New York group including Herbert C. Hoover, who at the time made extended examinations of the Pioche properties.

★U. S. Vanadium Corporation is completing installation of its central chemical processing plant for treatment of tungsten concentrate in a leased division of the huge Basic Magnesium, Inc., plant at Henderson. Blair Burwell, vice president, at Henderson recently, said the function of the new plant is to produce by its chemical process a minimum 65 percent concentrate from the low-grade product, around 12 percent WO_3, of the company's scheelite concentrators at the Pine Creek mine near Bishop, Calif., and the Riley plant, being enlarged, in the Potosi district, Humboldt County, Nev. Concentrate is being delivered to the stockpile at Henderson from both company plants, and a substantial supply is in prospect from smaller producers in several adjacent states, Burwell indicated.

★Mountain City Consolidated Copper Co. is "beating" the labor shortage problem. Its resourceful mine manager, M. E. Bohannan, has engineered a contract with a half-dozen husky Swedish miners from Butte, Mont., shaft "specialists," who are making fast headway in sinking the inside shaft from the

main adit to reach an orebody that last year's drilling indicated, 300 ft. below the adit level, to have an 18-ft. width of better than 20 percent copper ore. The 16-claim property adjoins on the west the productive Anaconda-operated Rio Tinto mine, which has shipped much high-grade direct-smelting ore in addition to concentrate from its 350-ton flotation mill. Mountain City Consolidated Copper Co., with a diesel power plant at its tunnel portal, has provided auxiliary compressor and pump units for sinking. George B. Thatcher, of Reno, is president and Pat Mooney, secretary.

★Newmont Mining Corporation has been moving equipment and supplies to the Bullion or Railroad district, 22 miles southwest of Elko near the Eureka County line, in preparation for reopening old tunnel workings that produced high-grade silver-lead ore in the early '90s. At Goldfield, 250 miles to the south, Newmont's Esmeralda operation is reconditioning the Silver Pick main shaft below the 500-ft. level, has provided electrically powered equipment in preparation for extended lateral work on the 700-ft. level, and is said to have resumed prospect drilling in the northern area drilled last year.

★At the notable deep-development project of the Eureka Corporation, Ltd., subsidiary of Ventures, Ltd., of Toronto, on Ruby Hill, two miles west of Eureka, the four-compartment Fad shaft is nearing the 1,000-ft. point. A station was cut at 800 ft., where connection will soon be made with the old Locan shaft, main outlet of the productive silver-lead mines south of the Ruby fault, by a 1,400-ft. crosscut on the Locan's 900-ft. level. The project, designed for major-scale production from orebodies revealed by diamond drilling at depths of 2,300 to 2,800 ft., with plans for milling facilities, is the most ambitious to be undertaken in the State in many years.

★For a number of years the Daisy mine, near Beatty, southern Nye County, has produced high-grade fluorspar. The concentrate from a small mill operated by the owner, J. Irving Crowell, of Beatty, is trucked 75 miles to Las Vegas for shipment to western steel plants. Bureau of Mines reports have appraised the Daisy fluorspar deposit as one of the largest and of highest quality in the country, but the owner has rejected offers to expand his market for the product or to supply eastern consumers.

★Work of reopening the old 1,700-ft. crosscut tunnel of the Nevada Equity Mining Co. at Austin, historic silver camp and county seat of Lander County, has made satisfactory progress, and needed equipment, including compressor and air pipe, has been provided. A 45-ft. stretch of caved ground at the 425-ft. point has been retimbered and another short caved section has been repaired. R. W. Hernlund is in charge at Austin.

★Operation of the Silver Hill mine and

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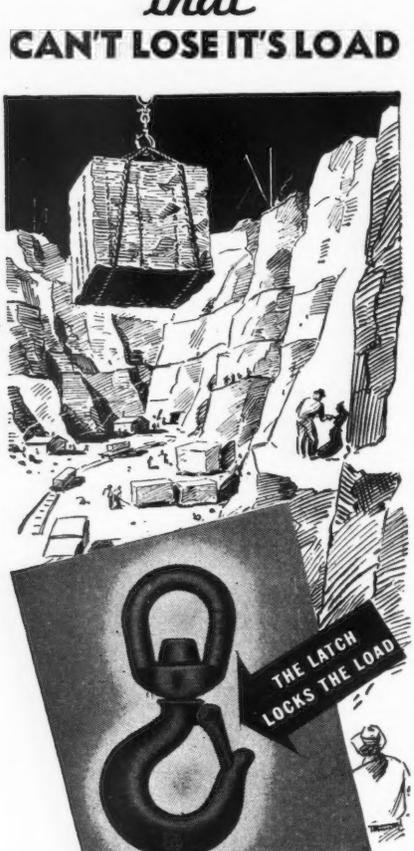

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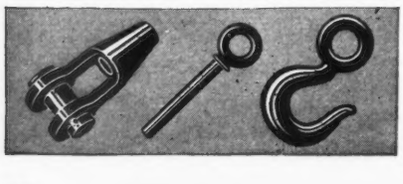

Nevada *(continued)*

100-ton Donovan cyanide mill at Silver City, in the Comstock district, has been resumed on a capacity basis by William Donovan, veteran operator of that district. Ore is mined both from an open cut and underground. At Silver City a company known as the Nevada Mining Exchange, Inc., is about to resume operation of the lately purchased South Comstock 100-ton flotation mill and is sinking a new shaft on the old Silver City mine.

WASHINGTON

Mead magnesium plant is declared surplus—Conference called to push mining-law revision

★American Zinc, Lead & Smelting Co., which bought the Leadhill claims, 15 miles north of Metaline Falls, on Slate Creek, a few months ago, started diamond-drill work with three crews in May, according to Dale I. Hays, western manager of the company. He said that because of man shortage the company was working at only 70 percent of capacity.

★Metaline Mining & Leasing Co. made its final payment of $9,861.54 in May to American Zinc, Lead & Smelting Co., thus eliminating its debt to that company, according to H. Louis Schermerhorn, of Spokane, president. A profit of $65,496.49 was made during 1945, before payments were made on the debt, but the company had a net loss for the year of $37,694.40 after paying $103,190.89 on its mortgage and other debts. Work at the zinc-lead property consisted of 1,587 ft. of drifts and raises, and 10,947 ft. of diamond drilling during the year. E. K. Barnes is treasurer of the Metaline company.

★Pend Oreille Mines & Metals Co., operating in the Metaline district, after four months of negotiations, agreed in May to grant a wage increase of 18½c. an hour, according to Jens Jensen, of Spokane, manager. Half of the increase will be retroactive to Jan. 24, when negotiations were opened, and the other half will be retroactive to May 1. The miners' union demanded a 30 percent wage boost, but reduced the demands when the Coeur d'Alene unions settled for an 18½c. increase.

★According to William Price, member of the Safety Division of the State Department of Labor and Industry, speaking at the Mining Bureau of the Spokane Chamber of Commerce on May 13, the Metaline district is to have a mine rescue car similar to the one used in the Coeur d'Alenes. This will be purchased by the department. A series of first-aid courses is planned for supervisors, foremen, and miners.

Mr. Price said that laws for the prevention of accidents are not being deliberately violated, but inspectors have found potentially dangerous conditions at some mines. Recently 400 tons of dynamite was found stored underground at one of the largest mines in the Metaline district, despite the fact that the State law prohibits the mine operator from storing more than one day's supply underground.

★First Thought Mine Corporation, of Orient, is planning a larger mill at its gold property. Before the war bullion valued at $184,300 was shipped from the mine, and before the mill was built 150 carloads, valued at $91,000, were shipped to the smelters at Tacoma and Trail, B. C. The ore belt at the property is from 15 to 110 ft. wide. The mine has a mile and a half of workings, with seven levels.

★The Mead magnesium plant, operated during the war by the Electro-Metallurgical Co., has been declared surplus, according to the War Assets Corporation, and the company's operating contract will be canceled on June 17. The company has a six-month option, following the date of cancellation, to buy the plant or any part of its facilities by matching bids of any outside bidder. It has been reported in Spokane that several concerns are interested in the plant, or units of it, for conversion to fertilizer production. The company has continued to employ 30 men in maintaining the plant, and indicated to the Spokane Chamber of Commerce some months ago that it was interested in taking over the property at the termination of its present contract.

★Articles of incorporation have been drawn up by Clarence C. Dill, former U. S. Senator, of Spokane, for National Silver Products Corporation, designed to handle northwest silver. Those behind the plan are hoping to arrange with Henry J. Kaiser to roll the silver into sheets at the Trentwood aluminum plant prior to fabrication. Arrangements for fabricating machinery costing nearly $500,000 have been made, and a suitable building for the plant is being sought in Spokane. "A number of inquiries from the East, indicating an interest in establishing manufacture of silverware in Spokane, have been received," said Frank Lilly, Spokane mining statistician, who will be president of the corporation.

★Mineral industry leaders in Spokane scheduled a conference in the city for the week of June 9 with Julius A. Krug, Secretary of the Interior, to discuss revision of federal mining laws to permit valid locations of deposits found by geophysical prospecting. Attacks have been made by the General Land Office on the validity of thousands of mining claims, many contests being in the Colville Indian Reservation in Ferry and Okanogan counties, and the committee plans to obtain information as to Secretary Krug's attitude on this subject. It is well known that many valuable ore deposits in the Metaline district are "blind" in that they lack surface outcrops. The committee feels that until the laws are clarified, millions of dollars expended in exploration

and development of such properties are in jeopardy.

★Nine hundred union workers returned to their jobs at the Tacoma smelter of the A.S.&R. on June 19, after being on strike since Feb. 25. According to Eugene A. White, manager of the Tacoma plant, an interval of two weeks would be necessary to bring production back to normal.

CALIFORNIA

Production of iron and mercury down in 1945—Pacific gold mine at Placerville to reopen

★According to a release by the State Division of Mines, W. W. Bradley, State Mineralogist, quicksilver produced in California during 1945 amounted to 21,063 flasks (76 lb.), valued at $2,697,835 f.o.b. mine, and came from 43 properties in 12 counties. This was a decrease in both amount and value compared with the 1944 output, which was 28,097 flasks, worth $3,178,969 f.o.b. mine, and came from 63 mines in 14 counties. California as in the past led all other states in the United States, with about 70 percent of the nation's yield. Quotations at New York for quicksilver started the year 1945 with an average of $156.85 per flask for January, going to a high of $165.55 per flask for February, then dropping to a low of an average of $95.84 for September, and ending the year with an average of $108 for December. The average of New York quotations for the year was $134.89 per flask, compared with $118.36 in 1944 and $195.21 in 1943. The California producer received an average of $128.08 for his quicksilver in 1945, compared with $113.14 in 1944 and $181.96 in 1943.

★Iron ore shipped from California properties during 1945 totaled 240,917 net tons, valued at $883,434 f.o.b. mine, and came from one property each in Riverside, San Bernardino, Santa Cruz, and Shasta counties. This was a decrease in amount and value compared with the 1944 output of 905,981 net tons, worth $2,360,694. The ore mined during the year was hematite from Riverside and San Bernardino counties, which went to the steel plant at Fontana, Calif., and was also used in the manufacture of high-iron cement and as foundry flux. Magnetite from Shasta County and magnetite sands from Santa Cruz County were both used as an aggregate in heavy concrete for ballast.

★Hollywood interests formerly operating the Texas Hill gold mine, near Placerville, El Dorado County, with L. F. S. Holland, general manager, have decided to reopen the Pacific gold property adjoining the Texas Hill, a substantial producer 25 years ago. The mine is developed to a depth of 1,800 ft., and test drilling has disclosed con-

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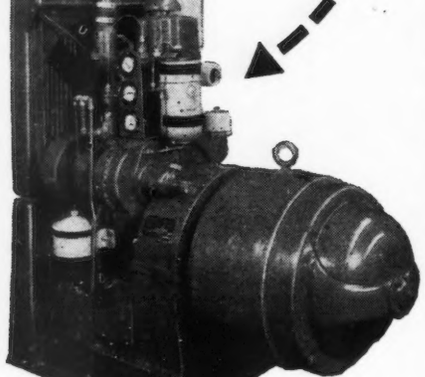

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California (*Continued*)

tinuation of a good vein of commercial ore to 2,000 ft.

★Argonaut Mining Co. reports a net loss of $20,877 for 1945. The company property at Jackson, Amador County, is being kept in maintenance condition by a small crew, and present unfavorable labor and material conditions make it impossible to predict when operations can be resumed. Alex F. Ross is general superintendent.

★The Mining Department of the San Francisco Chamber of Commerce, headed by George B. Dodge, is seeking the development of a plan for the world-wide marketing of domestically mined gold to assure future employment in California's gold-mining industry, according to a recent announcement. Industry representatives are now making efforts to arrange Washington conferences to develop a world-wide marketing plan. G. L. Fox, manager of the Chamber's industrial department, stated that few properties in 19 counties of the State are now operating, many having suspended work after issuance of WPB's Order L-208. Mr. Fox declared that "gold mining is essential to the economy of these counties, and thousands of jobs will be contingent on an adjusted price for currently mined gold or the opening of the world market to producers."

ARIZONA

Shattuck Denn reports favorable position at Iron King—Louis S. Cates honored by University

★Thomas Bardon, president of the Shattuck Denn Mining Corporation, told stockholders in the annual report that 6,154,213 lb. of copper, 8,985,940 lb. of lead, 22,358,801 lb. of zinc, 11,507 oz. of gold, 531,152 oz. of silver, and 13,136 tons of fluorspar were produced during 1945.

The Denn copper mine, at Bisbee, and the Iron King lead-zinc mine, at Humboldt, operated continuously. Production of acid-grade fluorspar concentrates at the Los Lumas, N. M., plant was discontinued about Sept. 1, 1945.

Development and exploratory work have been carried on at the mines owned and controlled by Shattuck Denn, Mr. Bardon stated. He added that no new ore was found at the Denn mine. The known ore of commercial grade above the 2,900 level, the present lowest working, is limited in quantity.

"During the past several months we have been receiving the 5c. a pound premium on copper and the ceiling price, or a total of 16.775c. a pound for copper produced at the Denn, which left little or no margin for depreciation of plant, depletion of mine, and profit," Mr. Bardon said.

At the Iron King mine developments underground have been favorable and ore reserves are being well maintained the report stated.

★Ben Joy and Pierre Perry, operators of the Yaller Kid copper mine, 6 miles northeast of Mayer, are optimistic about the future of the operation now that the price of copper has been raised. The patented claim on which the mine is located was purchased from the county for taxes two years ago.

The vein in the Yaller Kid is from 5 to 11 ft. wide, and a considerable amount of native copper has appeared recently. Two cars of 50 tons each were shipped to the Clarkdale smelter in one week.

★Approval of the proposed "right-to-work" amendment to the Arizona constitution was voiced by 84 percent of members of the Arizona Small Mine Operators Association. Five percent of those voting favored active opposition to the proposal, which is to be placed before the voters in November if sufficient signatures are gathered on petitions now in circulation. Eleven percent urged that the association remain aloof from the fight, which promises to grow more bitter as the campaign progresses.

★The Wage Stabilization Board has approved a $1.48 per day wage increase for members of the CIO International Union of Mine, Mill and Smelter Workers at three copper companies, Cornelius Morrell, president of the Miami, Ariz. local announced.

★Veterans forced out of work by the strikes at both the Morenci and Bisbee properties of the Phelps Dodge Corporation were denied unemployment benefits in a decision announced by the Arizona Employment Security Commission.

Fifty-four veterans at Morenci and nine at Bisbee had protested that they had not authorized the locals of the CIO International Union of Mine, Mill and Smelter Workers to represent them. Bruce Parkinson, director of the commission, said he was compelled to reject the veterans' plea under provisions of a law which provides that workers who are a part of a bargaining unit represented by a union are not entitled to unemployment benefits during the course of a labor dispute.

★Louis S. Cates, president of the Phelps Dodge Corporation, received an honorary degree of doctor of science at the University of Arizona commencement exercises recently. The degree was granted in recognition of Cates' outstanding achievements in the field of mineral industries, which have to a large extent been reflected to the advantage of the mineral industry of Arizona.

★Hot dog stands and other unsightly structures may soon be ruled off mining claims along the Catalina Highway in Arizona's Coronado national forest, according to the terms of a bill introduced by Senator Carl Hayden, of Arizona, at the request of the Tucson Chamber of Commerce. It provides that the Federal Government retain

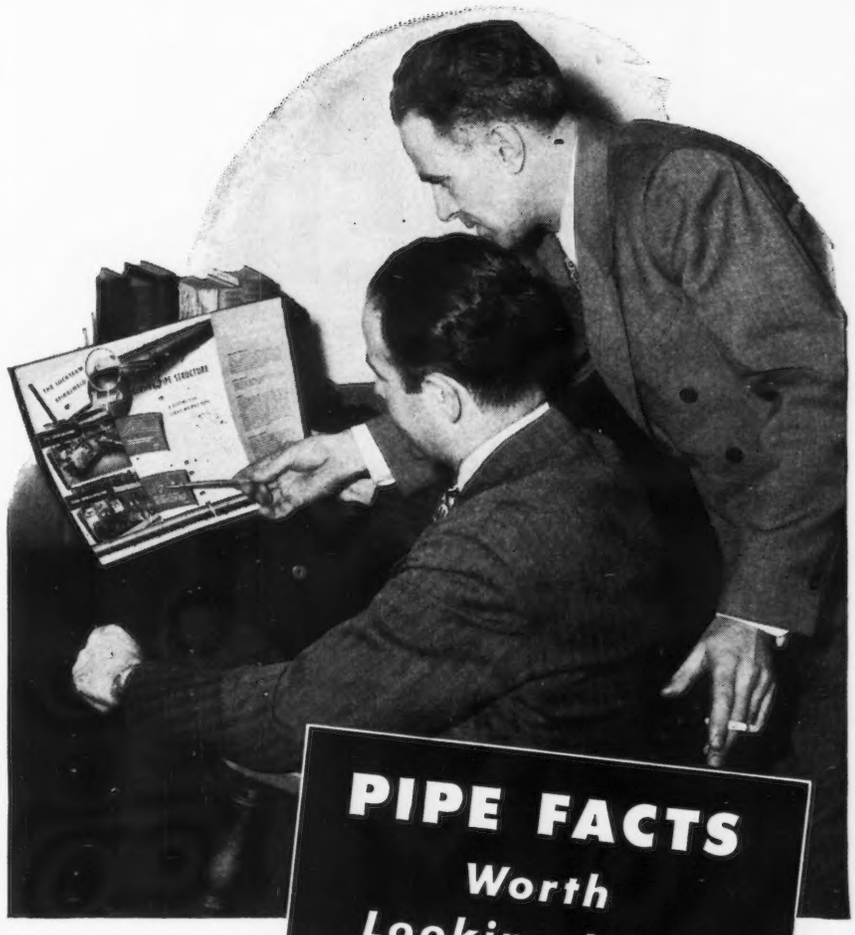
control of the surface of mining claims. It places no restrictions on mining but specifies that all building on mining claims must be used for mining.

TRI-STATE

Lead concentrate price advances to $99.96—IUMMSW wins bargaining agent elections

★With the lifting of the OPA ceiling price on lead effective June 3, and the announcement of a new smelting charge, the contract price of lead concentrates in the Tri-State market was advanced $23.95 a ton to $99.96. Eagle-Picher Mining & Smelting Co. announced the new smelting charge at $16.68 a ton, up $1.25 following a $1-a-day wage increase to smelter employees. As the contract price is based on 80 percent lead concentrates and a smelter recovery of 90 percent, or 1,440 lb. of metal to the ton of ore, the contract price is obtained by multiplying the recoverable metal in pounds by the East St. Louis price per pound less the smelting charge. The East St. Louis price under the OPA release automatically was increased 1.75c. a pound for pig lead, from 6.35c. to 8.10c. On the basis of the Eagle-Picher Central mill settlement price for lead concentrates, which was established in May 1940, the price of galena is computed by the ratio of 12 to 1; that is, 12 times the East St. Louis E. & M. J. average weekly metal quotation per 100 lb. The Eagle-Picher settlement price was approved through the Quapaw Indian agency by the Department of Interior about six years ago. The Central mill settlement price was increased from $76.20 to $97.20 a ton. The new metal price is the highest since 1929, when the New York level was the same. In March of that year the price of concentrates in the Tri-State market reached a high of $105 a ton. Early in 1925 the lead concentrate price advanced to an all-time high of $146 a ton on the local market.

★In a formal hearing held May 28 in the U. S. District Court at Miami, in response to a petition for certification of bargaining agents filed by the International Union of Mine, Mill & Smelter Workers (CIO) with the National Labor Relations Board, the Eagle-Picher Mining & Smelting Co. resisted the contention of the union relative to the composition of the employee bargaining unit. The company held that both mine and mill employees should comprise the bargaining unit, which has been the practice pertaining to other major mining companies in the Tri-State district that have had NLRB elections to determine bargaining agents for their employees. It was contended that the union had changed its tactics relative to the Eagle-Picher company, and that the union sought an election among only the mill, or surface department employees. A company



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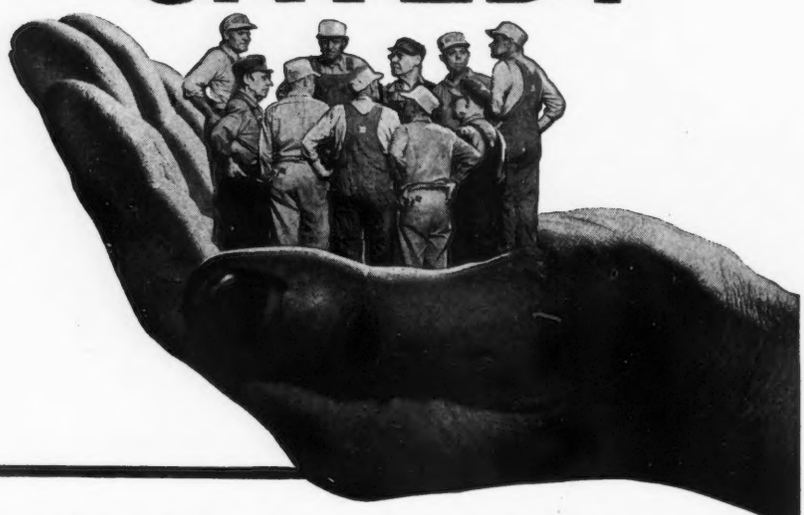

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Tri-State *(continued)*

spokesman pointed out that the company would have consented to an election without the necessity of a hearing had the union agreed to the inclusion of both underground and surface employees. Contentions of both the union and the company were heard by a NLRB trial examiner, who has certified the contested action to the National Labor Relations Board in Washington. Both parties will have time in which to file briefs with the national board, which probably will grant an opportunity for oral argument before handing down a decision.

★In a NLRB election held on the same date as the Eagle-Picher hearing, employees of the Cardin Mining & Milling Co. voted 91 to 25 to let the same international union represent them as their bargaining agent. The total vote cast was 118, out of a total eligible vote of 144, leaving 26 employees who did not cast ballots. The company operates four tailing re-treatment plants in the Picher mining area. They are the Cardin Nos. 2 and 3, Western and Captain mills. In a similar election held May 16, employees of the Scott Mining Co., which operates mines and a mill a mile east of Hockerville, voted 41 to 20 in favor of the union. On May 14, employees of the Big Chief Tailing Co., operating a tailing plant southwest of Cardin, voted 32 to 1 in favor of the union. Out of 15 employees of the Harris Mining Co., working at the old Evans-Wallower No. 24 mine, six voted in favor of the union and three against, the remaining six not voting. At the American Douthat mine, operated by the Harris company near Cardin, the vote was 16 to 4 in favor of the union out of a total vote of 20. In a "cross-check" election held among employees of Tri-State Zinc, Inc., which operates two tailing re-treatment plants in the Picher field, union officials said that the count showed 52 workers out of a total of 71 employees of the company named the union on their signed union application cards.

MISSOURI

Anomaly under investigation in Crawford County—School of Mines plans 75th anniversary

★L. E. Keeton and associates have started shipping barite concentrates from near Lupus, in Moniteau County. The concentrates average about 98 per cent $BaSO_4$ and are recovered by tabling material from old tailings ponds left by earlier operators. The plant has a capacity of about 100 tons of concentrates a day.

★An important magnetic anomaly has been discovered about 20 miles northeast of Steelville, in Crawford County, by M. E. Richards, mining engineer of Steelville. The anomaly is by far the strongest recorded thus far in Mis-

souri. Magnetometer readings have exceeded 100,000 gammas, and at least two dip-needle readings of 90 deg. have been recorded. The anomaly, probably caused by veins of magnetite in porphyry, is being investigated by the Missouri Geological Survey.

★The Park City Consolidated Mining Co. is planning an exploration program for lead ore near Annapolis, in Iron County.

★The Pittsburgh-Corning Glass Co. has constructed a plant at Sedalia to produce glass blocks and foamed glass. The source of the raw material has not been disclosed.

★Plans are being made to celebrate the 75th anniversary of the Missouri School of Mines on Nov. 2 to 9. As part of the ceremonies, honorary degrees will be awarded to selected alumni who are prominent in the mineral industry. Enrollment at the Missouri School of Mines during the summer term is approximately 900 students. This exceeds any previous regular semester enrollment.

ARKANSAS

Ozark Mineral Co. prepares to unwater antimony mine—Pike County quicksilver plant leased

★The geology department of the Arkansas Resources and Development Commission recently completed a survey of a clay deposit in the city of Magnolia, where construction of a brick plant is contemplated. Drew F. Holbrook was the geologist in charge of the survey for the commission, of which Harold Foxhall is director of geology. Indications are that adequate reserves of clay are available for the manufacture of common and structural brick. The clay occurs in the Claiborne formation of Eocene age.

★The Ozark Mineral Co., operating the Poorboy antimony mine, near Gillham, Sevier County, has arranged for construction of an electric power line to the mine. A new headframe has been recently completed and a mine hoist installed. Unwatering operations with electric pumps are expected to be under way soon. Actual mining operations will be started on completion of the unwatering program. Charley Spencer, a former operator of the antimony district and subsequently employed by the U. S. Bureau of Mines wartime bauxite exploration project, is mine superintendent in charge.

★The Crouch Mining Co., bauxite mine operator, has been conducting an exploration drilling program on some of its holding near Bauxite. J. C. Childress, of Little Rock, is the drilling contractor.

★The National Geophysical Co., of Dallas, Tex., is reported to be carrying on bauxite exploration drilling for the

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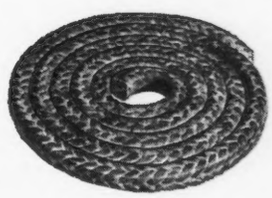

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Arkansas (*continued*)

Reynolds Mining Co. in the Arkansas bauxite district.

★Carl Wernecke, of Chicago, has the quicksilver reduction plant of the National Quicksilver Corporation, in Pike County, under lease. He has purchased a large quantity of surplus Government mercury-cell batteries which were developed during the war for use in the tropics. The batteries are being furnaced in the leased plant, and it is reported that substantial quantities of mercury are being recovered.

★The Magnet Cove Barium Corporation, of Malvern, recently suspended operations on its Gap Mountain barite property, in Montgomery County. No announcement of future plans for the property has been made.

★A news item appearing in this column in the May issue erroneously referred to Joe Kimzey, now operating in the Magnet Cove area, as State Geologist of Arkansas. Mr. Kimzey formerly held this post.

MICHIGAN

Calumet & Hecla coal shortage relieved—Quincy reports good results from reclamation

★With the arrival of a cargo of coal, the first received since last fall, Calumet & Hecla Consolidated Copper Co. resumed operation of the Lake Linden reclamation plant on June 10 after being shut down since May 10 because of lack of fuel. Work was resumed in all departments of the company on June 17.

In former years, Calumet & Hecla always carried a two years' supply of coal on its docks, realizing that a coal shortage could be calamitous to a district limited by transportation facilities and handicapped by rigorous climatic conditions. Because of Government regulations, the company has not been permitted to maintain an adequate coal reserve. "In spite of inadequacy," said A. H. Wohlrab, general manager, "the Solid Fuels Administration's allotment of coal to the company was only 180,000 tons, and this was later reduced by 5 percent last year to 170,000 tons. . . . Coal received up to November amounted to 140,000 tons, or barely enough to fill requirements to the latter part of February this year. . . . After considerable negotiation, sufficient coal was received to carry the company through to the opening of navigation in the spring."

★A reduction of $1,682,710 in valuation of mining properties in Houghton and Keweenaw counties has been recommended to local tax officials by Franklin D. Pardee, Deputy State Geologist and Appraiser of Mines for the Michigan Tax Commission, under a new system of valuing mineral lands for tax purposes, authorized by an act of the 1945 Legislature.

Under the new system, the geological division of the Michigan Conservation Department fixes the values, which are then subject to change by local boards of review. Under the old tax program, the Michigan Tax Commission fixed the valuations and then sat in judgment of its own work in the event of appeals. That policy prevailed for more than 25 years.

In Houghton County, Mr. Pardee recommends a total mine valuation of $2,230,130, compared with $3,647,840 a year ago, or a reduction of $1,417,710.

The biggest cut in the recommended valuations from last year are for the Champion, Globe, and reclamations of the Copper Range company, which were reduced from $750,000 last year to a recommended value of $250,000 this year. The appraiser also recommends a cut from $825,000 to $425,000 in the value of the Calumet & Hecla reclamations.

In Keweenaw County, the appraiser recommends that the Central mine, owned by Calumet & Hecla, be appraised by the local assessor, and that the valuation of the Ahmeek and Allouez together be cut $135,000.

★Calumet & Hecla has resumed operations at the Gratiot mine, in Keweenaw County, which has been idle since December, 1930. The surface plant is being repaired and shaft equipment will be installed. An electrical hoist is being moved from the Centennial mine to Gratiot to be used temporarily until a larger hoist is necessary. The Gratiot is bottomed at the 25th level, but most of the mining in the shaft was done between the 9th and 19th levels. The Seneca Mining Co., the former owner, ran a long drift from the Seneca 25th level into the Gratiot property and raised through the Gratiot shaft from that depth. Though the shaft opening is complete from the 25th up to the 21st level, no timbering was done in that section by the previous operators.

★Although its mine is shut down, the Quincy Mining Co. is getting good results from its reclamation plant at Mason, on Torch Lake. It is averaging a little better than 5½ lb. of copper from each ton of waste sands treated. This is better than a 70 percent recovery.

The average cost of production in 1945 was 10.59 c. per pound before depreciation and depletion charges, but with interest payments of $32,924.84 during the year to Metals Reserve included. This covered interest at 4 percent per annum on the unpaid balance of the advance made by Metals Reserve for the erection of the plant. Production of refined copper from the plant during the year was 6,066,700 lb. This was 484,955 lb. greater than in 1944. Present extraction is 12.91 percent above that for 1944.

Operating profit of the plant for the year, with all operating expenses but depreciation and depletion included, was $408,063.13, out of which $302,931.45 was paid to the Metals Reserve for reduction of indebtedness. The amount still due against advances for the erection of the plant as of Dec. 31, 1945, was $602,312.65. In the first quarter of the present year, this indebtedness was reduced by further payments of $61,092.20 from operating profits.

For the first four months of 1946, production of refined copper from the plant was 2,027,254 lb., with operating profits showing little change from those of the previous year. If Congress continues the premium price plan for another year, from June 30, 1946, it should be possible, according to W. Parsons Todd, president of the Quincy company, to pay off during that period, out of earnings, most of the indebtedness still due Metals Reserve for the erection of the plant.

The office of Metals Reserve, an agency of the Reconstruction Finance Corporation, purchases at 17c. per pound all copper produced at the reclamation plant. The copper is then resold by the Quincy company, as agent of the RFC, to manufacturers of copper products.

★Resuming formal graduating exercises after a two-year lapse during the war, the Michigan College of Mining and Technology on June 20 conferred the honorary degree of doctor of engineering on three distinguished alumni. The bachelor of science degree in various branches of science and engineering was conferred on 61 men and 4 women. In addition, the college granted 12 master of science degrees and 3 professional degrees. The recipients of honorary degrees were Edward H. Snyder, president of the Combined Metals Reduction Co., of Salt Lake City; Clyde E. Weed, general manager of mines, Anaconda Copper Mining Co., of New York; and Charles Will Wright, consultant on mining and geology for Mines, Inc., and until recently chief foreign mineral specialist of the U. S. Bureau of Mines. Mr. Snyder delivered the commencement address.

ILLINOIS and KENTUCKY

Operators back Ohio River flood wall project at Rosiclare—Inland completes Guill shaft

★Three fluorspar mining companies at Rosiclare, Ill., have resumed milling operations after being shut down since early in April by the coal shortage. The Rosiclare Lead & Fluorspar Mining Co. and the Mahoning Mining Co. began work May 29 and the Inland Steel Co. on June 3.

★Effective June 1, employees of the Inland Steel Co. fluorspar division were granted a 10c. hourly wage increase, according to announcement by Paul Richards, superintendent of the Rosiclare plant.

★Fluorspar operators at Rosiclare are

keenly interested in development of a project to secure an Ohio River flood wall for the town of Rosiclare. Periodic floods result in heavy damage to the properties, as mines are flooded and mill operations interrupted. A flood wall would afford protection to all major companies in the area.

A survey has been completed by U. S. Engineers, operating out of the Louisville district, and their report, which is understood to be favorable toward construction of the levee, was submitted to the War Department early in July.

The Aluminum Ore Co., the Rosiclare Lead & Fluorspar Mining Co., Inland Steel Co., and Mahoning Mining Co., as well as various business and civic organizations of the community, are lending full support to the project. A. H. Cronk, superintendent of the Rosiclare Co., is chairman of the Flood-Wall committee.

★Shipments from the Kentucky-Illinois fluorspar mines in 1945 aggregated 242,393 short tons, according to the minerals market report of the U. S. Bureau of Mines. The total value was $7,847,752. Fluorspar shipped from all mines in the United States last year was 323,961 tons. Of the total, Illinois, ranking first among the states in fluorspar shipments, shipped 147,251 tons, and Kentucky, 95,142 tons. Compared with the 1944 shipments, representing an all time high, last year's shipments from the district showed a decline of 46,657 tons.

★A new 450-ft. shaft has been completed by the Inland Steel Co. at the Guill fluorspar mine, near Salem, Ky. Exploratory work is under way at the company's Keystone mine in Kentucky.

ALABAMA

New company to operate iron-ore property at Gadsden

★Iron ore at the rate of 500 tons per day will be mined from the former Patterson mine, at Gadsden, by the newly organized Etowah Coal & Iron Co., A. Page Sloss, president, has announced. Engineers are said to have estimated reserves of approximately 5,000,000 tons of high-quality red ore on the company's properties, comprising 128 acres owned outright and an additional 178 acres held under long-term lease.

Construction of tipples and buildings, laying of track, and installation of machinery are well advanced. It is expected that around 200 miners will be employed when operations start in the near future. The mine is favorably situated for disposing of its output to nearby steel plants. It is said to be the only independent red-ore mine in Alabama.

G. R. Armstrong is vice president and consulting engineer, and R. L. Bains is general manager of the new company.

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ALASKA

U.S.S.R.&M. Co. and employees resolve wage issues — Placers active in Livengood area

★Wage differences between the U. S. Smelting, Refining & Mining Co. and its employees in the Fairbanks area have been settled after several weeks of negotiations. Local 444 of the International Union of Mine, Mill and Smelter Workers submitted proposals to the management, and credit is due both to the management and the union that negotiations were carried through to a successful conclusion without a strike or interruption of work.

The U. S. Smelting, Refining & Mining Co. is operating four of its eight dredges in the Fairbanks district. The Cleary Creek dredge will be moved to Little Eldorado Creek next year, and the operation of the other three dredges depends on the preparation of the ground in advance of the dredge. Four or five hundred additional men could be used at present, and it is expected that operations will be expanded now that the threat of a strike has been removed.

★Two prospectors from California have driven in over the Alcan Highway to prospect in the Circle district. Knute Nielsen and his partner, Phillip Larsen, expect to spend the summer in that district.

★Interest in prospecting in the Kantishna district is being revived as a result of the good condition of the McKinley Park roads which give access to the district. The Caribou Creek Mining Co., on Caribou Creek, is employing ten men on a dragline-placer operation.

★The Livengood district is experiencing the most active season since 1942, with six placer operations under way. Livengood Placers has started a two-year program of thawing and stripping which must be completed before dredging can be started. Five small properties are mining in addition to Livengood Placers. F. B. Parker is working on Olive Creek, John Jurich, Frank Mendrich, and Tom Carr are operating on Lillian Creek, Cecil Wells has started work on Amy Creek, and Ben Falls, on Wilbur Creek.

★Connie Morris reports that the Fortymile Mining Co. will mine 200,000 bedrock-feet with a crew of eight men this season. He states, also, that the longest airfield on the lower Fortymile has just been completed above Eldon Bench.

★Thomas Paskvan and his son are starting a small drift-mining operation in the Circle district in the Birch Creek area near Eagle Summit. They will employ five men this season and expect to expand operations when mining machinery becomes available.

★Oscar Enstrom will employ several men and a D-8 cat in cleaning up ground which was left by the American Creek dredge when it ceased operations in the Manly Hot Springs district. The dredge is still on the property but will not be used.

★The Walter Johnson interests, of California, have sent Henry Harris to Nome to supervise preparatory work for dredging ground just east of the town of Nome. A ditch will be constructed, and stripping and thawing will be started this year.

★Active production is expected to begin in July at the Nabesna lode property, in the Copper River district, according to Carl Whitman, manager. The mine has been closed the past five years, and it is expected that a crew of 15 men will start operations and be increased to 45 by fall.

★Alcoa Mining Co., Inc., has sent L. Litchfield, Jr., vice president, H. S. McQueen, chief geologist, R. F. Miller, F. A. Billhardt, and Ralph Smith, engineers, all of New York City, and E. A. Messer, an engineer, of Hillsboro, Ore., to Ketchikan for inspection work in connection with its operations in the lime rock quarry at Edna Bay. The company plans to ship 150,000 tons the first year. The rock will be used in the company's aluminum plant at Vancouver, Wash.

★Alaska mining companies have been advised that wage increases not to exceed 18½c. an hour for the majority of workers in the non-ferrous metal-mining industry of Alaska, and the districts of the Rocky Mountains and West, have been approved. On April 30, a fact-finding board recommended the pay increase.

★Hirst-Chichagof Mining Co., which once employed 100 men at its gold-quartz mine at Kimshan, Alaska. has had its general manager, Paul Sorenson, inspecting the property with the idea of reopening the mine. Mr. Sorenson said in Juneau: "We could start immediate operations if the labor situation would permit. Everything depends on the availability of labor and the wages demanded."

CANADA

International Nickel and Consolidated Smelters conclude labor agreements — Shaft sinking begun at Norbenite Malartic

★Representatives of the Canadian mining industry have submitted briefs to the Senate in support of the claim that tax relief is urgently required by the operating mines. The new federal budget is expected to allow new producers increased tax exemption and increased allowance for depletion of ore. Higher priorities and a larger supply

of labor are required to secure the increased gold production necessary to maintain dollar balances in foreign trade. A serious drop in exports has taken place in 1946, resulting from the cancellation of war supplies.

★Lead exports in the first four months of 1946 increased to $5,995,000 from $1,374,000 in the same period a year ago. Zinc exports increased from $6,435,000 to $9,891,000. There was a moderate reduction in copper exports, but aluminum dropped to almost one-tenth of the war rate. Nickel shipments declined from $22,848,000 to $18,239,000 and cobalt alloys dropped from $607,000 to $27,000. More stabilized foreign trade is expected to follow the stabilizing of world currencies after the Bretton Woods agreement takes effect.

★Widespread improvement in employment was reported for the seven major Canadian industries by the Dominion Bureau of Statistics. The general advance raised the index of employment from 167 to 168.5 (1926=100), the highest reported this year but the lowest since the summer of 1942. Mining employed 72,564, including 1,648 women (index number 86.8, compared with 84.4 on April 1, 1945, and 89.8 on the same date in 1944). Aggregate weekly payrolls on April 1, 1946, were 109; 1945, 102.9; 1944, 107.1. The payroll index for mining advanced 5.9 percent in the past year.

★A strike threat in the Sudbury district was removed by the signing of an agreement early in June between the CIO Miners' Union and the International Nickel Co. The agreement affects mine, smelter, and refinery employees, who are granted higher pay, a total of six statutory holidays each year, and union security. Employees who have worked less than five years with the company will get an annual vacation of one week with pay; those who have worked more than five years receive two weeks. Base wages were increased 10c. an hour, an additional 3c. going to the afternoon shift and 5c. to the graveyard shift.

In Quebec, a wage increase of 7c. an hour has been proposed for employees of Noranda, Waite Amulet, and Normetal. The Quebec Department of Labor has retained the services of one of its conciliators to act on conciliation boards to be appointed in the disputes involving Noranda and Lamaque mines. No international union is represented at Normetal, where negotiations were carried on directly between the company and employees. All agreements are subject to the approval of the National War Labor Board at Ottawa.

ONTARIO

★Steep Rock Iron Mines has reported ore shipments of 45,000 tons for this season to the end of May. The low figure was the result of the coal strike and the consequent shortage of ore boats. Adequate shipping facilities are expected to make possible a total

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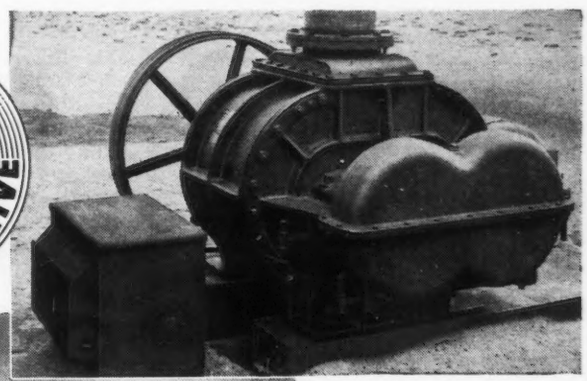

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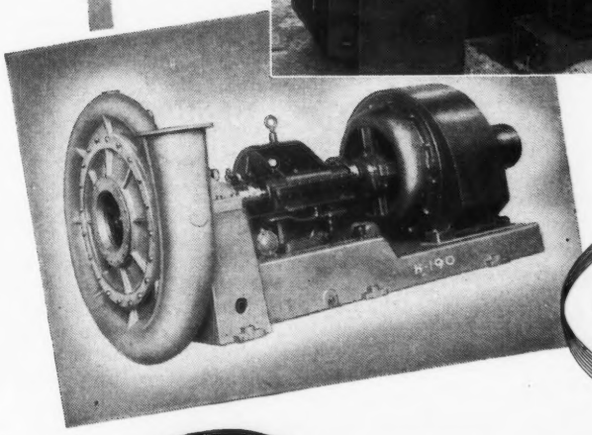

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Canada (*continued*)

output this year of about 1,000,000 tons. Regular shipments from the mine were advanced in June to 5,000 tons daily. M. S. Fotheringham is vice president and general manager.

★Gold was produced by 38 mines in Ontario, valued at $21,858,355 for the first four months this year, compared with $19,871,859 in the same period in 1945. The value was up 10 percent and tonnage increased 15 percent. Silver production was 2.37 percent lower.

★Magnet Consolidated Mines, preparing to work the adjoining Bankfield property on a royalty basis, has intersected a promising new gold occurrence while drifting out to the Bankfield boundary. At a point 370 ft. from the property line a drill hole cut 0.75 oz. material across a 3-ft. width. The hole was put out from the drift being advanced on the 11th level. New ore is also being opened on five levels in the footwall vein structure of the Magnet mine. The footwall and Magnet veins are believed to converge on the 10th level, where east and west drifts are being started. The mill rate will be increased from 90 to 150 tons as soon as labor is available. The property resumed production in March, having closed down in 1943.

★Pickle Crow Gold Mines is drilling below the bottom 2,450-ft. level to test the downward extension of the No. 1 vein. It is reported that values up to 1.76 oz. per ton have been secured by the 18 drill holes, each of which intersected vein material over widths ranging from 7 to 65 in. Deeper development is expected to follow. Sinking the new No. 3 shaft has been completed and eleven levels have been opened down to 1,600 ft. The winze or No. 2 shaft has been connected at the 750-ft. level with the No. 3 opening. Upper levels at the No. 3 shaft are to run out crosscuts above the 750 horizon to develop the No. 2 vein. A. G. Hattie is mine manager and John E. Hammell is president.

★Upper Canada Mines reports extending control of the No. 2 ore structure for a length of more than two miles by the purchase of the adjoining Brock and Eastward properties. In preparation for expanded operations, a new 100-ft. headframe is being erected for the No. 2 shaft, and a double-drum electric hoist capable of operating to a 3,000-ft. depth is being installed. The No. 2 ore zone has now been explored for a length of 2,000 ft., with both ends open. Mine workings have reached a depth of 1,250 ft. The No. 1 and No. 2 shafts are connected on the 375 and 1,000 levels, and a third drive is being extended at the 1,750 horizon. Roy Henry is general manager.

★Osulake Mines, on O'Sullivan Lake, 25 miles north of Nakina, has indicated ore over a length of 650 ft. The zone strikes into the lake and was reported to return good core in drill hole No. 116, another 50 ft. to the east of the detailed section. Drilling is being continued from the south shore of the lake.

QUEBEC

★J. H. C. Waite, president of Quemont Mining Corporation, reports ore reserves amounting to 6,000,000 tons averaging $6.98 gold per ton and 1.58 percent copper. Latest drilling results have indicated a higher copper content. A new orebody has been indicated at a horizon 200 ft. below the main zone that was tested in the large-scale drilling project last winter. The new zone is 15 to 25 ft. thick and appears from drill results to date to have a higher value than the main ore lens. Exploratory holes are being put down vertically from the 900-ft. level to this new area. Four ore zones are now known on the property. Quemont is controlled by Mining Corporation of Canada.

★Walter J. Blair, president and mine manager of Chimo Gold Mines, reports important ore intersections from two drill holes 90 ft. apart on the property in Vauquelin Township. The gold-bearing zone occurs in graywacke and interbedded tuffs underlying iron formation. The high assay from Hole No. 17 was $14.25 gold per ton across 5 ft.; from Hole No. 19, $12.70 across 5 ft. The property adjoins Raymond Tiblemont Mines.

★Norbenite Malartic Mines, north of Marbenor and Malartic Goldfields, is preparing to sink a three-compartment shaft to 540 ft. with levels at 125-ft. intervals. A concrete caisson is being sunk through 38 ft. of overburden to bedrock as the first stage of sinking operations. E. A. Goranson, consulting geologist, states that diamond drilling, completed in April, amounted to 38,910 ft. in 66 holes. Ore amounting to about 500,000 tons has been indicated to a depth of 300 ft. for a 900-ft. length, in the north zone. The average grade is estimated at $6.89 per ton. Other ore possibilities tested include the south zone, where a 500-ft. section averages $5.11 per ton across a width of 2.6 ft.

MANITOBA

★The annual report of Sherritt Gordon Mines, Ltd., for the year ended Dec. 31, 1945, discloses that net profit for the period was $415,881.65, equivalent to 7c. per share. Gross earnings were higher than in the previous year, but taxes were higher, due to the fact that write-offs for depreciation and deferred development have been exhausted. A total of 646,092 tons of ore was milled, from which were produced 26,234,400 lb. of copper, 18,722 tons of zinc concentrates, 7,154 oz. of gold, and 229,703 oz. of silver. Ore reserves were reduced by 35.4 percent of the tonnage milled during the year and were, at the year's end, 2,026,000 tons grading 2.65 percent copper and 2.25 percent zinc. This figure includes 117,500 tons in the east mine, where there are also 33,500 tons of zinc ore grading 8.66 percent zinc. The report also discloses that the company's equity in Michipicoten Iron Mines, Ltd., has increased from 60 to 70 percent. Progress at this operation has not been up to expectations, labor and delivery difficulties having delayed production until shortly before the end of the year. Exploration was successful during the period under review, the outstanding event being the nickel-copper discovery at Lynn Lake. Sherritt Gordon Mines, Ltd., controls three other prospects in the Granville Lake Mining division which would probably be of value in the event that power and transportation became available in the area. The balance sheet as at Dec. 31, 1945, lists current assets at $2,493,052 and current liabilities at $593,619.

At the annual meeting, shareholders authorized the suspension of dividends in order to finance the development of the Lynn Lake nickel-copper discovery. Eldon L. Brown, president, announced that 1,400,000 tons of material averaging 0.84 percent nickel and 0.55 percent copper were indicated by the drilling of the "B" anomaly to a depth of 900 ft. On the "A" anomaly a total of 250,000 tons averaging 1.65 percent nickel and 0.66 percent copper has been proved, with the north end open. Underlying this "A" deposit, and slightly to the west, preliminary drilling has indicated a much larger body of similar material. Drilling the "E" anomaly has delimited the south end of this deposit, but the north is still open. Tonnage to date is approximately 60,000, averaging 1.20 percent nickel and 0.64 percent copper. Several new anomalies have been discovered by magnetometer survey. Tonnage objective has been set at 20,000,000 tons.

Laboratory tests conducted have shown that the ore is particularly amenable to concentration by flotation, and that unusually high-grade concentrates are obtained. These tests will later be proved by pilot-plant operation. The company has complete ownership of the property and plans to finance the preliminary underground exploration and the pilot-mill operation. An offer by Falconbridge Nickel Mines, Ltd., to participate in the venture has been rejected at least until such time as major financing is considered. One point which will assist greatly in development is that the mining plant from the East mine, at Sherridon, will be available in time for preliminary mining at Lynn Lake, and the main plant, at Sherridon, will probably be available before permanent production starts. This would mean a saving of about two million dollars in capital expenditure.

The company's report for the first quarter of 1946 shows that at the Sherritt Gordon mine 162,841 tons of ore were milled, with a production of 5,772,267 lb. of copper and 4,750 tons of zinc concentrates. Realized profit for the period before write-offs was $271,665.24. Shortage of labor is still

curtailing production and development work. Zinc concentrates are now being sold to Hudson Bay Mining & Smelting Co., Ltd., at a somewhat higher price than that obtained in the United States market.

★Sherritt Gordon Mines, Ltd., has optioned a group of claims 10 miles east of Flin Flon on Pine Root River to Hudson Bay Mining & Smelting Co., Ltd., the latter organization obtaining a 60 percent interest for bearing the entire cost of the first two years of exploration. The geology appears favorable for base metals, and a geophysical survey has outlined several anomalies which will be drilled.

★Hudson Bay Mining & Smelting Co., Ltd., reports that net earnings for the first quarter of 1946 were $1,961,610, or 71c. per share. This compares with net earnings of 51c. per share for the same period in 1945, and a net for the year of $2.14 per share. Tonnage milled was 455,952 for the period under review, compared to 445,996 tons for the first three months of 1945.

BRITISH COLUMBIA

★Forecasts of a boom year in British Columbia mining failed to take into account the wave of labor unrest that has swept Canada during the past six months. It was predicted that material shortages would be overcome within the year, and in large part this has been accomplished, but the problem of mine labor deficiencies has not been solved and the situation is deteriorating.

The single note of optimism sounded in recent weeks comes from Consolidated Mining & Smelting Company of Canada, Ltd. Because of the extensive nature of Consolidated operations, the recently concluded agreement between that company and the I.U.M.M.S.W. is one of major importance, and its effect on the industry in general is seen as both favorable and adverse.

At Trail, a new wage scale has been developed based on job evaluation. It is intended that a joint committee of unions and management will further develop job evalution and correct any inequities in the job classifications. The bonus system under terms of which employees shared in profits on a metal price basis, will be eliminated, and, in lieu thereof, increases in the present base rates of pay will be made, amounting to an average of $1.60 per shift. As conditions permit, the working week will be gradually reduced to 40 or 42 hours, as prevailed at Trail during the prewar period. A system of shift differentials will be established on the following basis: 5c. per hour premium to employees working on the night shift; 3c. per hour to employees on the afternoon shift.

The existing holiday plan will be extended to provide for reduction in the requirements for a full two weeks' holiday with pay, from 12 years' service to 5 years' service. One week's holiday with pay for employees with from 1 to 5 years' service will continue.

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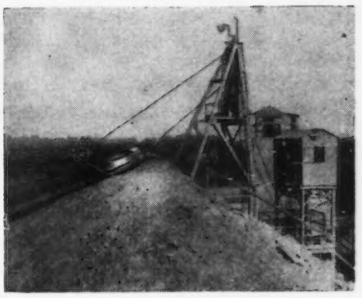
A 20 h.p. Sauerman Slackline Cableway operating a small bucket on 1,000 ft. track cable, reclaims tailing from dump in valley to bin on hillside above mill.



At a phosphate processing plant, a 2½ cu. yd. Sauerman Scraper operating as a slackline, reclaims slurry from soaking pit to hopper, besides dragging newly mined matrix out into pit to soak.

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Canada *(continued)*

It has been agreed that a committee will be established to study and make recommendations regarding a contributory pension plan.

A variable interim adjustment has been agreed to in addition to the following basic wage scale. At present the interim adjustment would be at its maximum of 40c. per man-shift. Accordingly, 5c. per hour should be added to the following hourly rates to compute correctly the wage scale plus interim adjustment on the maximum level:

Laborers, 77c.; helpers, 80c.; operators, 83c. to 89c.; chief operators and repairmen, 92c. and 98c.; miners and timbermen, 95c. and 98c.; journeymen tradesmen, $1.01; toolmakers and job classifications equivalent in rating, $1.04; steam engineer, 2d class, $1.07; barmen, $1.10.

This new agreement should stabilize conditions at Consolidated's operations, but gold and copper operators are confronted with the eight-point demands of the I.U.M.M.S.W and the probability that the union will call a strike if these demands are not met at least in great part. The union is demanding 29c. per hour wage increase, holidays with pay, union security, shift differential, guaranteed minimum 1,900 hours of work, and severance pay, among other things. Most operators have countered with offers of 50c. per shift pay increase, as a maximum. Strike votes have been taken at Bralorne, Copper Mountain, and Premier, with others to follow.

At the request of Hon. R. C. MacDonald, Minister of Mines, representatives of the operators and the union met on three occasions early in June in an effort to clarify the situation. The union is demanding a district-wide agreement, refused by the operators.

In some operations, at least, it does not appear economically possible for operators to accede. It has been pointed out that wage increases have exceeded increases in the cost of living. An example given was the Granby Consolidated Mining, Smelting & Power Co. operation, where wages have been increased (including the current offer of 50c. per shift) by 44 percent since 1939, compared with the government cost-of-living index up 22.

At the conclusion of the conference, operators agreed to present the union's contentions to the individual companies concerned and to advise the union as to final decisions. Meantime it has been announced that if no progress is made toward an agreement, the government is willing to appoint a neutral chairman to convene further meetings. The union has expressed its unwillingness to submit disputed points to conciliation, as provided by the law.

★A wooden tugboat and five steel barges have been specially built in Seattle and Bellingham shipyards for delivery to Taku Vessel Co., a subsidiary of Taku River Gold Mines, Ltd. They will be used to transport supplies and equipment from Juneau, Alaska, to the Polaris-Taku mine, at Tulsequah, B. C., and to haul concentrate to the Alaskan port by return. All have been designed to overcome navigation hazards in the shallow Taku River.

The Taku mill is being increased to 500 tons daily capacity by easy steps. Two more levels will be opened in the mine, with shaft sinking now in progress. Polaris-Taku Mining Co., Ltd., a wholly owned subsidiary of the Taku River company, has already expended more than $200,000 in preparing the property and plant for renewed production, which will start this month. Of this sum, $64,000 was paid for the adjoining McDougall group of claims, which is known to hold the extension of the strike of productive veins. Officials at the property include: Frank H. MacPherson, general superintendent; D. Sykes, mine superintendent; Dave Yorston, mine foreman; William B. Tobey, chief engineer; and Harvey Parliament, geologist.

★The most important development in the revival of silver mining which began last fall is the consolidation of the Porter Idaho, Prosperity, Silverado, and Silver Range properties, at Stewart, Portland Canal mining division, under the newly incorporated Big Four Silver Mines, Ltd. The company is capitalized at 4,000,000 shares of par value of 50c. each and is financed by Transcontinental Resources, Ltd., W. B. Milner and associates, Karl J. Springer and associates, and Col Victor Spencer. It is planned to extend the Silverado transport-adit into Prosperity ground and then drive raises to reach former workings. Construction of a 150- to 200-ton mill is under consideration at a point on the beach below the Silverado portal, and the company's consultants have suggested the dismantling of the Porter Idaho tram-line, maintenance of which has been costly on account of stations on the shifting Marmot glacier, and re-erecting it to connect the projected mill with the Silverado camp. Development work has started under the direction of Dr. J. T. Mandy, consulting geologist, and Russell F. Palmer, mine manager.

★Silbak Premier Mines, Ltd., received net smelter returns of $52,603 for May production, recovered after treatment of 5,834 tons. Operating loss was estimated at $898.

★The lower tunnel being driven by Stewart Canal Gold Mines, Ltd., has reached 150 ft. of its projected length of 250 ft. Two strong veins, one 7 ft. wide and the other 3 ft. wide, have been cut and will be opened after the objective has been reached. Present work is designed to check the downward persistence of three orebodies discovered 125 ft. higher by previous underground work.

★Employees of Britannia Mining & Smelting Co., Ltd., and Granby Consolidated Mining, Smelting & Power Co., Ltd., have received a bonus of 25c. per shift since June 1 as a result of the increase in the price of copper and provisions in the copper-bonus system adopted by both companies.

★The strike of employees of the Tacoma smelter has had repercussions in the Bridge River district, where more than 18 carloads of concentrate from the Bralorne mine await shipment.

★A second vein has been encountered within a week by the extension of the winze to establish a new low level at the Bridge River property of Congress Gold Mines, Ltd. The last vein was intersected at a depth of 248 ft. below the main haulage level and averaged 0.3 oz. gold across 27 in.

★The annual meeting of Olympic Gold Mines, Ltd., was advised by G. S. Eldridge, president, that a contract has been let for drifting on the vein recently intersected by diamond drilling. A contract has also been let for driving 225 ft. of drift on a vein already developed on two levels, 80 ft. apart, at the Eldorado mine, also in the Bridge River district. Olympic holds a 65 percent interest in the promising B. R. Jewel property, west of Bralorne, where diamond drilling is in progress.

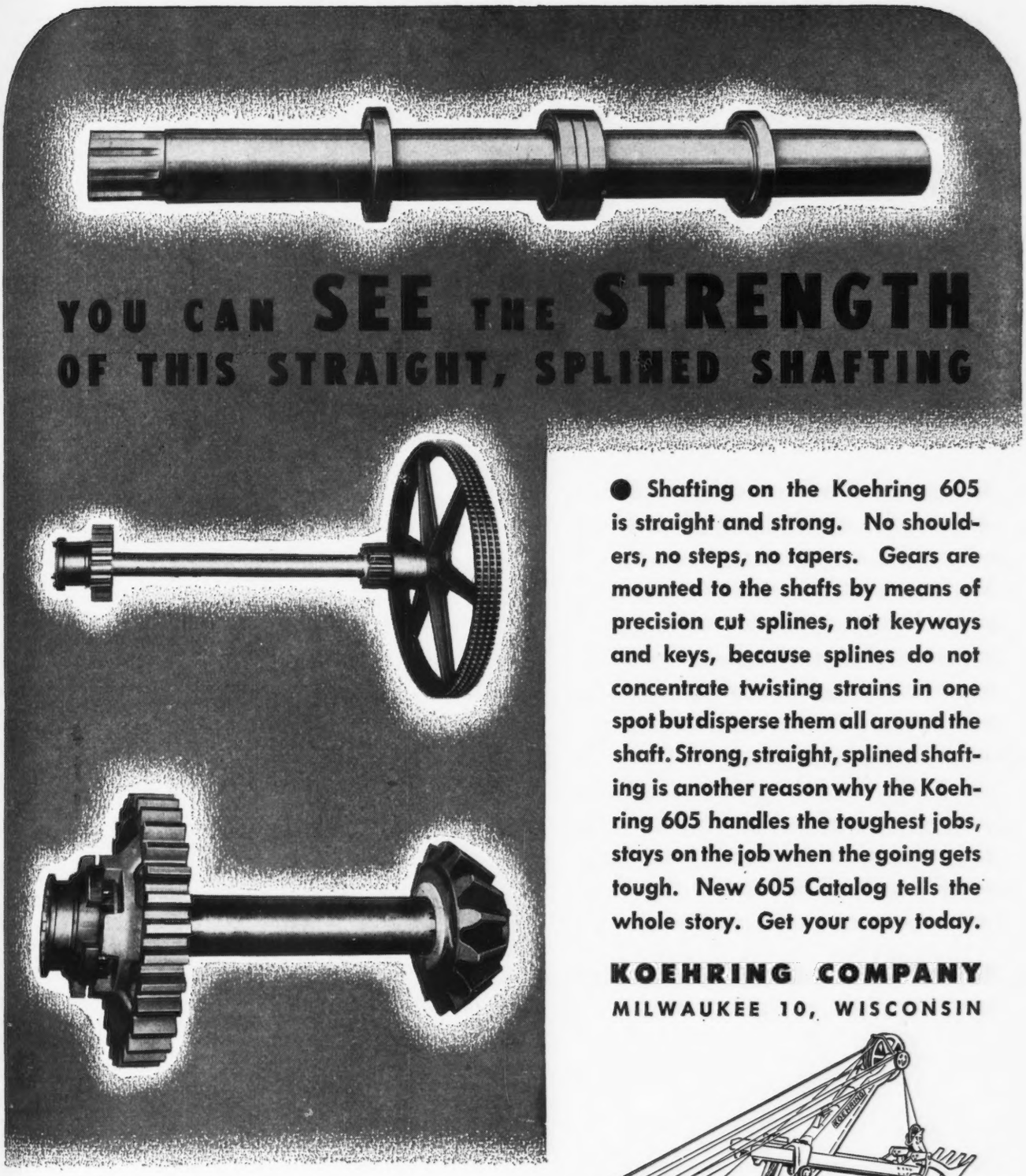
★Two veins, showing commercial width and grade, have been intersected in the current diamond-drilling programs in effect at the Pavilion mine of Rusdon Gold Mines, Ltd. Drilling will be continued to establish length and depth of the veins, after which equipment will be installed to extend the Pavilion tunnel, already driven to 648 ft. Dip of the veins suggests intersection at a total length of 1,100 ft. George R. Bancroft has been retained as consulting geologist.

★May production of Cariboo Gold Quartz Mining Co., Ltd., was 2,305 oz. gold, valued at $88,723, from 6,775 tons, averaging 0.34 oz. gold per ton. R. R. Rose has resigned as managing director after a service of 12 years. P. N. Pitcher has been appointed acting manager pending the naming of a permanent successor. Dr. F. C. Buckland, of Toronto, has been appointed consulting engineer and will visit the property this month. A noted English geologist, Dr. A. C. Skerl, will make a detailed geological survey and map of the Cariboo property, commencing this month. Work on the Westport group, now held by Williams Creek Gold Quartz Mining Co., Ltd., will be deferred until the present unsettled labor conditions become clarified.

★May production of Island Mountain Mines Co., Ltd., was 1,583 oz. gold, valued at $60,961, from 3,419 tons, averaging 0.46 oz. gold per ton.

YUKON TERRITORY

★Reno Gold Mines, Ltd., former British Columbia lode-mine operator, has begun development of its placer leases, covering four and one-half miles of dredging ground on Canadian Creek, with a view to initiating dragline oper-



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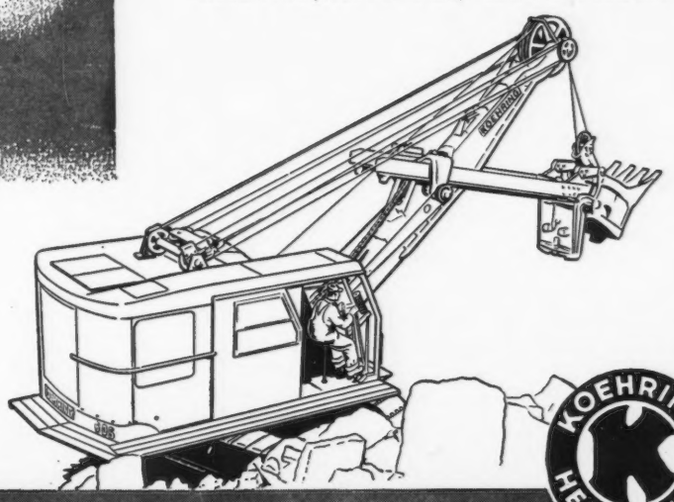

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HEAVY-DUTY CONSTRUCTION EQUIPMENT

Canada (*continued*)

ations this summer. A 15-mile stretch of road requires reconditioning before dredging equipment and floating washing plant can be transported to the property. O. C. Thompson, managing director, estimates reserves of 1,557,000 cu. yd. with an average gold content of $1.06 per cubic yard, and expects to effect recovery at not more than 30c. per cubic yard. It is intended to salvage the considerable tungsten content of the gravel.

★Yukon Consolidated Gold Corporation expects to have its sixth dredge in operation in the Klondike area by July, according to W. H. S. McFarland, general manager. He had a payroll of 350 in May, more than half of them being newcomers to the company, and expected the number to be increased to 475 at peak production. Company camps were opened in May at Guggieville, Hunker, Quartz, Granville, Middle Sulphur, Upper Dominion, and Middle Dominion. Besides dredge work the company will do extensive thawing and stripping work on Lower, Middle and Upper Sulphur, Quartz, Middle Dominion, and Hunker. If enough men are available the company hopes to work on Sulphur ditch.

CHILE

Manganese mines reopen — Pay rise at Andes; strike on at Chuqui—Dealings in gold

★Although Cia. Siderurgica de Valdivia, situated at the port of Corral, has been producing pig iron and steel for many years, it has not been a successful business operation except during the war years when steel was scarce. The company uses high-grade iron ore from the Bethlehem mine, at El Tofo, and for fuel makes use of charcoal obtained from local trees known as coigue and tepu. Costs are unusually high, however, and in an attempt to redesign the plant for cheaper operation, the services have been engaged of two Swedish engineers, Messrs. Aspegren and Hollander, of the firm of Aspegren & Co. Because charcoal blast furnaces are used in Sweden, it is hoped that the experience of these engineers will be of value.

★The new iron and steel enterprise to be established on San Vicente Bay near Concepcion has been incorporated in Santiago under the name of Cia. de Acero del Pacifico. Assisted by an Export-Import Bank loan of $28,000,000, the undertaking will have a capacity of 180,000 metric tons of pig iron per year, and various steel shapes will be supplied to fill domestic needs. Chilean coal, mixed with imported American coal, will be coked for use in the blast furnaces, and power for electric alloy steel furnaces will be furnished by the new El Albanico hydroelectric plant.

★Renewed interest in Chilean manganese has been shown recently by American buyers. Mines shut down since the U. S. Commercial Co. stopped its purchases in July 1944 have reopened as a result. Ores carrying 46 percent manganese and low in phosphorus and copper are supplied by the firm, Manganesos de Atacama, most important Chilean producer, with mines at Corral Quemada near La Serena.

★The Chilean sulphur industry is having a struggle to meet the competition of Texas and Louisiana sulphur after the prosperous war years, when all of its production could be disposed of in the markets of Argentina and Brazil. Only two companies survive at present: Minera del Pacifico and Aucanquilcha. Caja de Credito Minera is studying the problem of finding cheaper production methods.

★Considerable quantities of monetized gold from Chile, Peru, Colombia, and Mexico are being sold in Buenos Aires, and it is likely that some of this gold finds its way into the black markets of Europe and the Orient. An interesting feature of these sales of gold is that the gram of gold in each type of coin is priced differently. Gold in the English pound brings 9.58 Argentine pesos; then comes the American eagle at 8.68 per gram, followed by the Mexican eagle at 5.84 per gram; lastly comes the Chilean Condor at 5.74 Argentine pesos per gram. Familiarity with the coin in question seems to be the arbiter.

★Difficulties between Andes Copper Mining Co. and its workers have been settled by direct employer-employee negotiation that resulted in a wage increase of 3 pesos per shift for men on A and B shifts and 3.50 pesos for men on the C, or night, shift. The employees of Chile Copper Co., 7,000 strong, went out on strike late in May following the taking of a strike vote.

Production of Principal Chilean Copper Mines

	Metric Tons		
	Chile	Andes	Braden
December	21,597	(*e*) 2,014 (*b*) 3,710	10,309
January	20,316	(*e*) 1,414 (*b*) 3,458	5,303
February	15,421	(*e*) .... (*b*) 2,708	6,725
March	20,743	(*e*) 3,601 (*b*) 3,412	7,871

(*e*) Electrolytic.
(*b*) Blister.
Chile's is all electrolytic and Braden's is all fire refined.

BRAZIL

Hanna Exploration gets iron-ore concession—Drills hit high-grade gold ore

★Hanna Exploration Co., an American mining company, recently was granted a concession to mine and export iron ore in the territory of Amapa, in northern Brazil. The concession covers two areas of 1,000 and 1,500 hectares in the districts of Macapa and Mazagao. The company will build a rail connection to the coast and will pay a definite royalty per ton of ore exported. The company also agreed to sell up to a maximum of 150,000 tons of ore per year to a local blast furnace, to reserve 50,000 tons of freight space for local use, and to divert 25 percent of the power it will generate to government use. The project is financed on a 50-50 basis by the company and the State Government.

★Transcontinental Resources, Ltd., Canadian mining and exploration company, has been advised of spectacular ore discoveries at its Macaco gold property, in Brazil. The No. 5 diamond drill hole is reported to have cut, at 215 ft., a 15.7-ft. width assaying $63.14 per ton, and at 387 ft., a further width of 4.5 ft. assaying $77 per ton. Hole No. 4, 200 ft. distant along the strike, had previously intersected at 170 ft. a width of 3.5 ft. averaging $18.50, and again at 415 ft. a width of 1.3 ft. assaying $5.10.

MEXICO

Trouble seen if silver price rises—Union asks compensation for tuberculosis

★Currently, the situation in Mexican mining is cloudy. On the one hand, an impression seems to be growing among producers that the demand of the Miners' Union for pay increases in non-silver mines of up to 40 percent may be settled without strikes. Several companies have already signed contracts with the union that call for pay increases and other benefits. On the other hand, there is the view taken by Mariano Atcocer, economist for the Bankers' Association of Mexico, that a rise in the price of silver in the United States to $1.29 would be more of a bane than a boon to Mexico. In contrast to some, who hold that such a price increase would help mining, Mr. Atcocer believes that a silver price increase of that magnitude would go far toward wrecking Mexico's whole economy. By making silver so valuable, the price increase would force the issuance of many millions of paper pesos, an inflation that Mexico cannot afford at present.

★Gold, silver, and copper properties in

Chiapas are to be developed soon by Ernesto Rios, No. 32 Cinco de Mayo, Mexico, D. F. Situated in the Santa Fe zone south of Pichucalco, the orebodies were once worked by the British-owned Chiapas Mining Co., but transportation difficulties are said to have halted the enterprise. Recent rail and road construction in the region have so improved communications that an attempt to mine in the area has again become feasible.

★Among other things asked by the Miners' Union at its recent convention was a request to President Avila Camacho that he aid the miners in establishing tuberculosis as an occupational disease in mining, as is silicosis at present, and in furthering the observance of profit-sharing plans in the mining industry. The President is said to have replied that suitable studies of both matters will be made by the Government. The union is conducting a census of its more than 85,000 members in an attempt to find out how many of them have, or have had, tuberculosis.

AFRICA

Double-tax plan dropped — Tax problem still troublesome—Profits and tonnage increase

★Some idea of what the new mining taxation formula means to the Rand gold mines may be gleaned from reports of annual meetings of these companies, but the future tax picture has been clouded by the limitation of the revised income tax measure to the six-month period ended June 30, 1946. Presumably, further tax revisions may be announced with the next budget in February or March, 1947, which would then be retroactive to July 1, 1946. Meanwhile, uncertainty over the treatment to be accorded mining companies must still prevail.

★Dividends received by holding companies would have been subject to income tax, under proposals advanced in the new tax bill, but it was reported early in June that Mr. Hofmeyr, South African Finance Minister, had decided to drop this plan. This form of taxation had been strongly denounced by Rand interests, inasmuch as the result would be double taxation, the mining companies' profits having already been taxed before they were turned into dividends.

★At meetings of companies in the Union Corporation Group, P. M. Anderson presiding, mention was made of the probable continuing trend upward of mining costs. Relief under the new tax proposals will amount to 30 to 40 percent of the wartime levy. Exploration was being carried on, or initiated, at Marievale, Van Dyk, Grootvlei, Geduld, and East Geduld.

★John Martin, presiding at the annual

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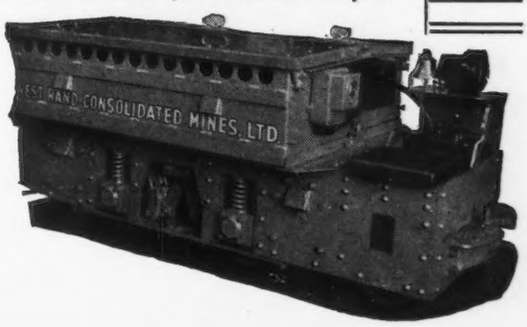

meeting of Rand Mines, referred to the Transvaal gold mining industry as being currently in a transition stage. During the war, he said, it was the task and duty of all the mines to subordinate all working conditions to keeping gold output at the high level which the national interest demanded. Development work was drastically curtailed to secure maximum production, which resulted in decreased costs and increased profits, subject, however, to heavy taxation. Many mines now face the problem of enlarging development programs at a time when working costs have risen and labor is in short supply. Mr. Martin also estimated that operating mines, under the new formula, would still be paying only a little less than two-thirds of their taxable profits.

★Lydenburg Platinum, Ltd., reports that in the quarter ended March 31, 1946, five boreholes were being drilled on the company's Free State holdings, two of which were completed in that time. Of these two, Hole K.B. 1 cut the Leader Reef at 5,399 ft. assaying 3.0 dwt. over 8.2 in.; it cut the Basal Reef at 5,457 ft. assaying 0.7 dwt. over 6-in.; and was stopped at 5,813 ft. The other hole, V.K.2, drilled jointly with Free State Development and Eastern Rand Extensions, cut a reef that assayed 3.2 dwt. over 52.5 in. and then cut the Leader Reef with an assay of 10 dwt. over 12.5 in. The hole was stopped at 4.471 ft. without striking the Basal Reef.

★Blinkpoort Syndicate drilled four holes in the Odenaalsrust area in the first quarter of 1946 and three in the Heilbron area. One of these was the Geduld No. 1 hole that caused the recent flurry in O.F.S. shares. One of the others, Rietpan No. 1, drilled 2½ miles south of Odendaalsrust, intersected the Basal Reef at 4,959 ft., assaying 19.2 dwt. over 6.7 in., and a deflection cut the Reef, assaying 39.9 dwt. over 6.7 in.

★In reporting on its drilling activities from Oct. 1, 1945, to March 31, 1946, Free State Development & Investment Corporation refers to the almost complete impossibility of getting a complete core recovery from Basal Reef intersections. The difficulty lies in the presence of friable seams in the Reef, which are caused by concentrations of carbon. Total footage drilled in the period was 51,208 ft., of which 11,304 ft. was drilled by other companies in joint boreholes.

★According to the *Financial Times*, of London, a general increase in profits of Rand mines was experienced in May. Blyvooruitzicht set a new record, covering its own operation, of 29,500 tons milled for a profit of £114,056. Daggafontein's profit of £230,077 was also a record, and tonnages milled by Sub Nigel, Vlakfontein, Grootvlei, Marievale, and Van Dyk were at record levels. The industry seems to have recovered completely from the bad effects of the series of strikes that cut production and profits in March. Comparative group figures for March, April, and May are given in an accompanying table.

Comparative Group Results, Rand Mines

Group	Tons Milled — March	April	May
Anglo-American	604,000	711,000	719,000
Anglo-Transvaal	214,000	219,000	(*a*)
Barnato	716,000	805,000	871,000
Corner House	1,329,900	1,461,100	1,541,800
General Mining	228,000	274,000	281,000
Gold Fields	503,500	602,000	642,500
Union Corporation	556,000	596,000	602,500

Group	Profits, £ — March	April	May
Anglo-American	259,355	504,260	504,212
Anglo-Transvaal	66,675	84,712	(*a*)
Barnato	54,701	201,609	199,616
Corner House	238,140	490,965	553,771
General Mining	62,398	130,068	128,508
Gold Fields	214,782	358,754	402,808
Union Corporation	483,333	568,154	591,470

(*a*) Not available at press time.

★Legislation to safeguard regional planning in the Orange Free State will be introduced at the next parliamentary session, according to Mr. Hofmeyr, South African Minister of Finance. Meanwhile, it will be unlawful for any person to use land for any purpose for which it has not previously been used, or to subdivide land without approval of the controlling authority.

AUSTRALIA

To test aluminum therapy—Gold strike near Darwin—Big Bell's motors still missing

★The Australian mining industry is actively interested in the use of aluminum dust in the control of silicosis, and the matter has been under investigation for about twelve months, with the Australasian Institute of Mining and Metallurgy acting as co-ordinating body in the general effort. Close contact has been maintained with MacIntyre Research, Ltd., Canada, and the Institute also supported the concerted effort to arrange a visit to Canada and the United States by Dr. W. E. George, of the Bureau of Medical Inspection, Broken Hill, New South Wales, who is now on his way to investigate the present status of aluminum therapy. The Government of Western Australia has introduced legislation empowering the Minister for Mines to enforce the installation of the process in the change houses of mines in the State; although inhalation of the dust would be optional on the part of employees.

WESTERN AUSTRALIA

★Effect of Commonwealth Government control on matters affecting the mining industry is well shown in the operating conditions at Big Bell Mines, Ltd. This company is working a large, low-grade gold deposit, which before the war was producing 50,000 tons of ore per month. The ore was treated by fine grinding and countercurrent decantation. During the war the Government impressed a large generator forming part of the power plant, and four 225-hp. motors from the mill. Although the matter of return or replacement of impressed machinery was put forward more than twelve months ago, and Big Bell Mines resumed preparatory and development work more than six months ago, nothing has yet been done toward the return of the urgently needed machinery.

★Labor for mining is becoming more plentiful in the State, and attention is being directed once more to exploration and development. Western Mining Corporation, Ltd., which has taken a prominent part in mineral exploration in Western Australia over the past 15 years, has taken a two years' working option over leases at Southern Cross, containing the Fraser's line of lode, and has taken up other adjacent leases. The Fraser's line was discovered and opened up before the discovery of Coolgardie and Kalgoorlie. The lode is quartzose, with increasing mineral in the lower workings, occupying a shear zone of considerable length, near the junction of granite and amphibolite. The lode, which is a mile long, is from 10 to 50 ft. wide, and is intersected by pegmatite dikes. Work ceased at about 350 ft. from surface after production of about 350,000 tons of ore which returned an average of 10 dwt. gold per ton. A geological survey has been made, and it is intended to start diamond drilling on an extensive scale, although drilling some ten years ago failed to disclose any important evidence.

★North Kalgurli (1912), Ltd., is working a group of leases near the northern margin of the Boulder Belt, on the Kalgoorlie gold field, and the mine has promise for a long life. Recent work at the No. 6 level from the North Kalgurli shaft gave values of 7.4 dwt. gold per ton from 37 ft. of driving, and 8 ft. wide of stripping assayed 25.2 dwt. per ton. Driving in another section gave an average value of 8.6 dwt. and stripping for an additional width of 3 ft. assayed 150 dwt. per ton. At No. 10 level, from the same shaft, 32 ft. of driving was in ore with an assay value of 19.5 dwt. gold per ton. Ore worth 8 dwt. was reported at No. 2 level. At the No. 2 level of the Kalgurli shaft ore worth 17.7 dwt. was exposed for a length of 25 ft. and stripping for a width of 13 ft. assayed 22.4 dwt. per ton.

NEW SOUTH WALES

★The dredge of Wellington Alluvials, Ltd., on the Macquarie River, below the town of Wellington, has resumed operations after being closed since December, 1942, because of manpower difficulties. The company, which is an offshoot of the Broken Hill Proprietary Co., Ltd., holds an area containing 60,000,000 cu. yd. of dredgeable ground, which is worked by a dredge of 250,000 cu. yd. monthly capacity. The dredge pontoon is 212 ft. long, 68 ft. beam, and 12 ft. 6 in. deep. The bucket band contains 110 manganese steel buckets of 14-cu. ft. capacity, and gold is recovered by Bendelari and Crangle jigs. Installed power is 1,500 hp., and electric current is obtained from the Lithgow power station, 110 miles distant. The dredge has been working two months since resumption, producing 584 oz. of gold from 154,000 cu. yd. in the first month, and increasing output to 772 oz. from 208,000 cu. yd. in the second month.

★Increased development and production work has been reported by North Broken Hill, Ltd. Labor is returning to the field, and the rise in output can be expected to continue. Stoping has been resumed, after a long period of idleness, in the Junction section, once the property of the Broken Hill Junction Lead Mining Co., situated to the south of the main leases of the North Broken Hill company. In the last four-weekly report, 652 ft. of development had been completed, including the sinking of the No. 2 main shaft for a distance of 195 ft. below the 2,920-ft. level. In the same period 1,075 ft. of diamond drilling was also completed. Ore treated increased from 29,592 tons in the previous four weeks to 31,373 tons, concentrate production and grade being: Lead concentrate, tons, 6,244. Assay: lead, per cent, 72.3; silver, oz., 36.0; zinc, percent, 4.9. Zinc concentrate, tons, 6,352. Assay: zinc, percent, 51.1; silver, oz., 1.4; lead, percent, 1.0.

VICTORIA

★The leading dividend payer of the State, A. I. Consolidated Gold, N.L., at Gaffney's Creek, is likely to reduce the rate of dividend distribution with the depletion of the high-grade ore and the exposure of increasing quantities of lower-grade quartz. A dividend of 3s. per share has just been paid, bringing the total distributions by the company to £A310,500. This is particularly interesting in view of the government-controlled selling prices of shares, which has operated during the greater part of the time this sum was being distributed. Although the company was paying approximately 20s. per share per annum the ceiling price imposed on the stock exchanges was 10s. per share, which limit has recently been raised to 11s. In the last financial year the mine produced 5,081 tons of ore, which yielded 10.24 oz. of gold, which realized £A98,273. Production in the previous year was 3,442 tons of

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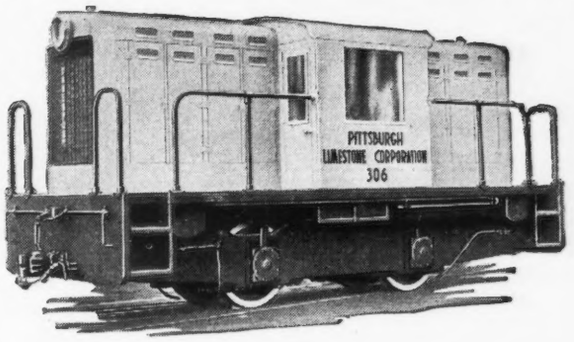

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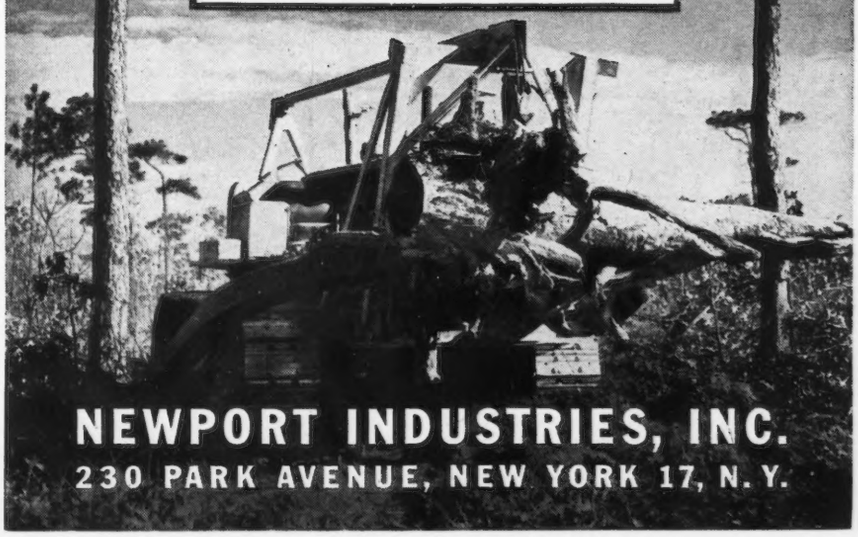

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Australia *(continued)*

ore for a return of 14,061 oz. of gold, with a value of £A125,320. These recoveries were by amalgamation; gold return from pyritic concentrate in the last year was 354 oz., worth £A2,863, from 94 tons of material recovered by tables and strakes.

NEW ZEALAND

★The Council for Scientific and Industrial Research is investigating the occurrence of radioactive minerals throughout the Dominion. These minerals occur in several localities and are present in the dredge concentrates from the west coast of the South Island. A party of seven Government scientists is engaged in the investigation, which is centered in the coastal areas of the island. Minerals identified in the dredge concentrates include uranothorite, monazite, thorite, gadolinite, titanite, xenotime, and hyacinth. Uranothorite and monazite are the only minerals which occur in sufficient quantity to appear of economic importance. Concentrate from one dredge contains 3 percent of uranothorite and that from another dredge contains 8 percent of monazite. It is uncertain whether their recovery as byproducts is commercially feasible.

NORTHERN TERRITORY

★Gold was found in 1943 at a point 60 miles south of Darwin, but because the find was close to an RAAF airfield, no claim could be filed on it or mention made of it until recently, according to an announcement in the Sydney papers. Discoverer of the gold was A.I.F. Major E. Schwenke, of Inverell, N.S.W., who has applied for four 20-acre leases covering the find. The mining branch of the Northern Territory government reported that ore from the property ran 20 oz. gold to the ton.

Washington Reflections

(Continued from Page 93)

accurate determinations of traces of metals in the ground waters, or in rock outcrops, surface deposits, vegetation, and stream sediments. Such determinations may provide useful information regarding the location of ore deposits. The Survey plans first to make geochemical prospecting studies in active mining districts, so that whatever new methods are devised may be carefully checked with known conditions before being applied to virgin territory. Research on new, faster, and more accurate methods will necessarily constitute a large part of the project during its initial stages. It will involve investigating of spectrographic, polarographic, colorimetric, and fluorometric methods of analysis. The initial geochemical program is set up in a four-year plan.

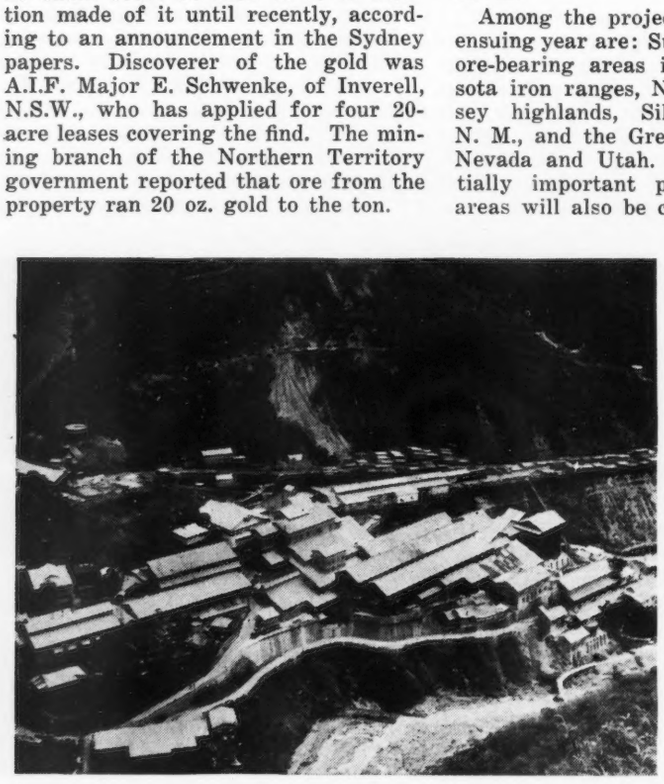
Since 1944 the Survey has been experimenting with an airborne magnetometer (*E&MJ*, June, p. 70). During this time surveys using this technique have been made in the Iron County of Michigan; Custer, Washita, Roger Hills, Becknam, Greer, and Canadian counties, Okla.; Worcester and Wicomico counties, Md.; the Adirondack Mountains; Alaska; the Big Horn basin, Wyo.; Alabama, New Mexico, Colorado, and Utah. This work will be continued during the next fiscal year, in addition to new studies involving geological interpretation of areas of industrial interest on a scale that cannot be undertaken by the industries themselves.

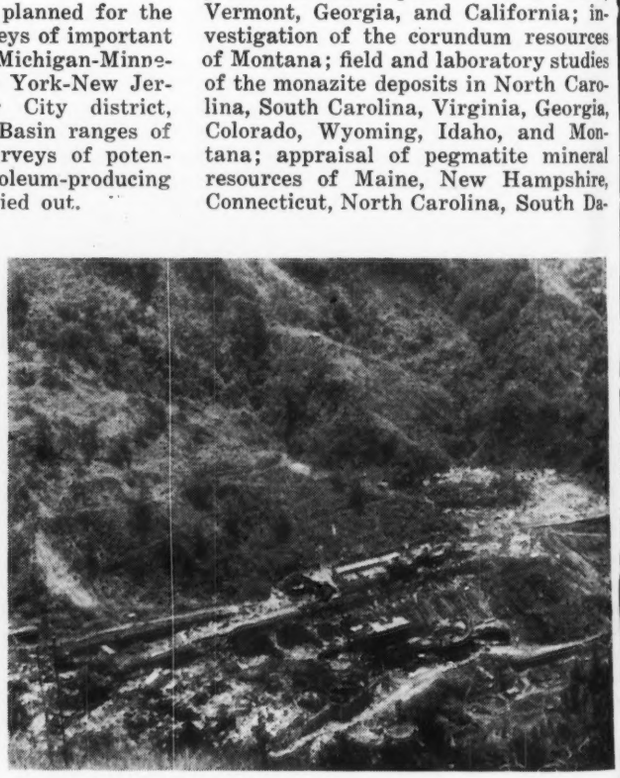
Among the projects planned for the ensuing year are: Surveys of important ore-bearing areas in Michigan-Minnesota iron ranges, New York-New Jersey highlands, Silver City district, N. M., and the Great Basin ranges of Nevada and Utah. Surveys of potentially important petroleum-producing areas will also be carried out.

Since the cessation of hostilities, broad regional studies have been undertaken or resumed to work out the pattern and character of certain already known metalliferous deposits in order to determine the geological reasons for their location, and to map regions geologically unknown or inadequately known which hold promise as potential sources of valuable deposits. The present program includes active studies of 19 states, and is in the main concerned with copper, iron, lead, zinc, gold, silver, tungsten, and mercury.

One very important program will be the appraisal of our uranium and thorium resources. This will be a continuation of work already begun, but on a larger and more detailed scale. This has been ordered by Congress.

To strengthen knowledge of the reserves of fluorite, beryl, talc, potash, phosphates, mica, graphite, corundum, bauxite and high-alumina clay, asbestos, magnesite, and other light metals, the Survey plans 12 projects. They are: Mapping and appraisal of potash deposits in California, Utah, Colorado, New Mexico, Texas, Oklahoma, and Kansas; investigation of the phosphate resources of Florida, Tennessee, Wyoming, Montana, and Idaho; preparation of a report on the magnesite deposit near Gabbs, Nev.; appraisal of barite deposits in Georgia, Tennessee, Arkansas, and Missouri; studies of strontium deposits in Texas, Arizona, and California; investigation of fluorite deposits in Kentucky, Illinois, Colorado, Nevada, and New Mexico; mapping and appraisal of talc deposits in New York, Vermont, Georgia, and California; investigation of the corundum resources of Montana; field and laboratory studies of the monazite deposits in North Carolina, South Carolina, Virginia, Georgia, Colorado, Wyoming, Idaho, and Montana; appraisal of pegmatite mineral resources of Maine, New Hampshire, Connecticut, North Carolina, South Da-





CONTRASTING VIEWS OF THE PROPERTY OF BENGUET CONSOLIDATED MINING CO. before and after the Japanese occupation of the Philippines depict the almost complete havoc wrought by the invaders. Just before the American reconquest of the area in April, 1945, the mine plant, mill, and all buildings were destroyed. Only a few partly stripped diesel engines and two generators were found undamaged. The mine workings were caved. Formerly Benguet was the largest gold mining operation in the islands.

kota, Colorado, and New Mexico; field and laboratory studies of the origin of bauxite and kaolin in Arkansas; special investigations of undeveloped resources of high-grade ceramic clays and shales in Kentucky, Utah, and Maryland.

Lake Superior Meeting

(*Continued from Page 94*)

George W. Johnson, Mayor of Duluth, welcomed the gathering at the opening session, following which attention was immediately directed to the program in hand. L. B. Hunter, manager of Inland Steel Co.'s lake fleet and representing Clarence B. Randall, vice president of that company, presented management's viewpoint. References to safety in the course of the coal strike, he said, had made the metal-mining men look at their own records. There had been no such references to safety in connection with the recent strike at the iron mines. This, however, should not cause complacency. The question is, what is the morale of the miners going to be? Management's task is to bring about good morale, and, in building this, safety is important. The key to safety is carefulness.

Truck Haulage and Safety

"Safe Truck Haulage" was the topic of three speakers at the opening session. Hugh J. Leach, assistant superintendent for Cleveland-Cliffs Iron Co. at Marble, on the western Mesabi, discussed the operation phase, pointing out the main causes of accidents due to truck operation, and making suggestions as to reducing the hazards.

Accidents involving trucks, tractors, and road patrols used in relation to mine operation, he said, totaled 332 in the nine years since 1937, when heavy-duty truck haulage really got under way in Minnesota iron mines. Fourteen of these were fatal, no case being due to mechanical failures, though some indicated lack of good training.

Three classes of accidents—namely, those due (1) to trucks out of control or in collisions, (2) to trucks running off roads, over banks and dumps, or into an embankment and overturning, and (3), to vehicles running into and injuring other employees—made up 21 percent of the total number cited for the nine-year period and included 12 of the 14 fatal accidents. (Only those accidents are reported from which a lost-time injury developed.) An experienced, intelligent dump man is probably the best insurance against over-the-dump accidents, and his selection should be given thought.

Truck doors serve to protect the driver while in the cab, and should be closed when a truck is in normal operation. Hood sizes of heavy screen, or cab ventilation, may be used to avoid discomfort.

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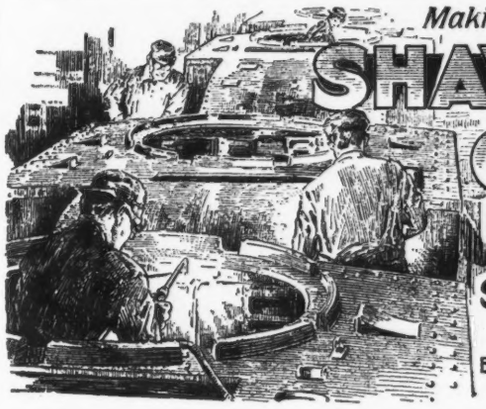

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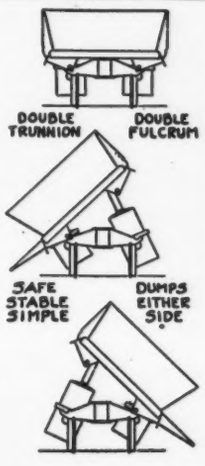

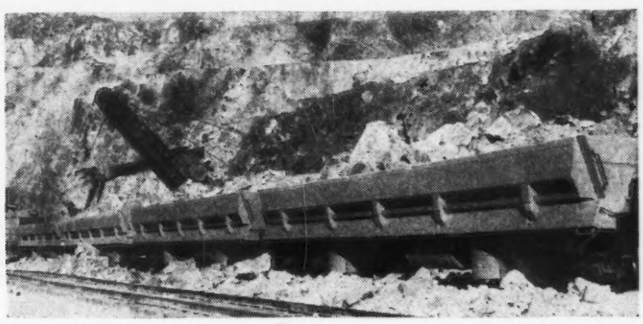

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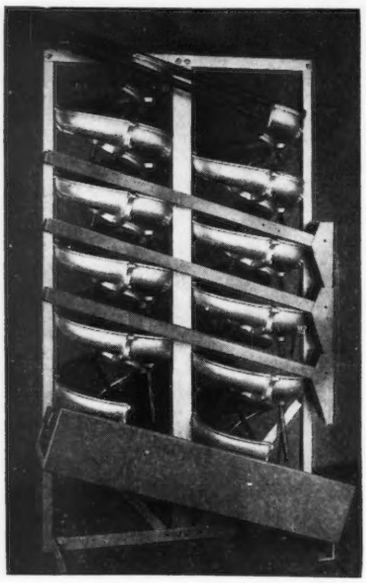

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Lake Superior Meeting

(*Continued from Page* 139)

road should be driven on. All trucks drive from the left, and left-side driving would appear to offer maximum advantage. Signs could be used at the pit entrance to avoid confusion.

Accidents when a man is injured by being run into usually show carelessness, and can be prevented. A horn signal to be used before starting should reduce the hazard.

Spinning steering wheels are responsible for the largest single group of lost-time accidents, 13 percent of the total of recorded cases being thus caused. The remedy is power-steering. Such accidents are definitely preventable.

Twenty accidents were due to falling dirt, near the truck. Six were due to slides of frozen dirt while cleaning truck boxes; five to rocks striking dumpmen while dumping; and nine to dirt falling from dipper or box while loading. Aside from the box-cleaning accidents, the others are preventable. The driver should stay on the truck while loading, or stand well away. With closed doors he is safe.

Summing up, Mr. Leach found that generally the most serious accidents are those caused by collisions and by trucks running off the road or over a bank or dump. Remedies include more and better training of operators, marking of the road with reflectors for night work, better lighting of roads and dumps, and care in selection of dump men and equipment operators, as well as of the equipment itself. Next in order are the accidents caused by vehicles running into employees other than those by whom the vehicles are driven. The remedy is more care by the men on the machines and those working around them and the use of warning signals when the machines are moved. Finally, accidents from spinning steering wheels can be avoided by use of steering boosters.

Maintenance and Safety in Truck Haulage

Charles A. Lindberg, supervisor of truck maintenance at Virginia, on the Mesabi, for Oliver Iron Mining Co., discussing the maintenance phase of safe truck haulage, considered it in its broadest aspect, including the field and shop sides of the problem.

Heavy-duty trucking of iron ore really began in 1937, when Butler Brothers started with three 15-ton trucks on the Cuyuna Range and the Oliver company purchased four 20-ton units for use at the Spruce mine, on the Mesabi. In 1945, half of the tonnage of ore shipped was moved at the mines by truck, or 32,731,000 tons, and 68 percent of the stripping, or 34,586,000 tons. Of the grand total of 116,013,000 tons of all materials shipped or moved in the area last year, 58 percent was handled by truck. To move this tonnage 700 trucks were required.

Trucking accidents increased more slowly than did the use of trucks, amounting to 17 percent of all time-losing accidents for the nine years 1937-1945. In round figures the record is one accident for 1,005,000 tons in 1945, compared with one accident for 389,000 tons in 1937. Four of the fatalities, it seems, could have been averted by a warning horn or signal used each time the vehicle was moved. The record indicates the importance of maintaining such accessories, including also rear-view mirrors, windshield wipers, stop lights, and back-up lights. For pushing or turning jobs in the pit or around the garages, Mr. Lindberg recommended the use of rigid tow bars and proper hooks or towing hitches on the front and rear of each truck.

Equipment Heavier

Truck construction has trended to larger, heavier equipment, and existing equipment is being made heavier and provided with larger tires. Maintenance equipment, such as lifting tackle, jacks, and the like, must keep pace. New equipment should be selected with an eye to the future. According to 1945 records, 20 percent of the trucking accidents involved strains due to lifting or pushing. Many occurred while handling tires. Instruction should be given in correct ways of lifting.

Few accidents were caused by mechanical failure, the total being 8 out of 332 for the nine-year period. In these, all truck components that can contribute directly to accidents were represented—namely, front tires, front wheels, and steering, service, and emergency brakes, drive lines, and truck frames.

The tire safety record has been good. It is promised that postwar tire quality will be better than that of prewar tires. Hazards inherent in inflation of the tire have been met in various ways. For example, tires are placed in various steel cages while being inflated. Or the tire is inflated while flat on the floor with the lock ring down and with an inflation chuck clamped to the air valve. This valve and the pressure gage are on the wall at a safe distance. Rims and lock nuts must not be continued in service too long.

Power steering is gaining acceptance, as indicated by fewer accidents from jackknifing steering wheels in 1945. Old equipment can be readily converted.

Attention to Brakes

Increased attention to initial design and specifications for brakes give the operator a greater margin of safety in brake maintenance. The trend also provides increased storage and larger compressor capacities with improved control devices. An improved emergency service brake system can now be had as standard on new trucks.

Hand emergency brakes still offer a problem, the main difficulty being that

the driver fails to release them. A solution for this difficulty is to install a pull-type air valve in the linkage between the brake hand lever and the brake mechanism to take air from the main reservoir and feed it to the rear brakes. This gives a good parking brake but compels release of the emergency brake before the truck can move. The emergency brake must still be kept in good condition to hold the truck standing when there is no air pressure.

Brake maintenance should have additional reserve to be able to stop the truck if the drive lines fail, causing loss of the drag of engine and transmission and of use of the emergency brake. Means should be provided to limit movement of broken shafts, as with yokes or shaft tunnels, lest they cut air lines and thus destroy the braking system.

Recent engines using volatile fuels stored under pressure have brought in new hazards which appear to be well controlled.

Larger clutches, with air assists to lessen driver fatigue, and larger transmissions, have been necessitated by increased capacities of trucks and engines. Better designs of driver's seat and better location of controls have also received attention. These changes promote efficiency and safety.

Hoists are not a safety problem save where they are inadequate. Frame design and materials are receiving much attention.

Two schools of thought exist as to truck maintenance. According to one, the truck finally selected is overhauled regularly at stated times. According to the other it is allowed to run to its practical limit, with mainteance keeping up with production.

Tires Important

Tires in respect to safe truck haulage were also discussed, the speaker being Fred O. Kittell, manager of the tire department, Malkerson Service, Minneapolis. After briefly describing the materials used in tires, he pointed out that each manufacturer makes a number of tread styles, each for a definite place and application. These include traction treads, shallow treads, and free-rolling treads. Used properly these will give the truck the safest footing possible.

In handling tires, one should bear in mind that a tire is like a high-pressure boiler that has never had to pass a Hartford or state inspection for safety. Mr. Kittell outlined the following procedure:

1. Remove the valve core by hand or by tool, before handling. Every tire must be completely deflated before anyone works on it.

2. Before using tools, find out the recommendations of tire makers and tool manufacturers regarding the procedure to be followed.

3. If the lug nuts are badly frozen, don't try to break them loose with an oversize wrench, but first use a penetrating oil as a persuader, plus a few taps on each nut as pressure is applied.

4. Before removing the locking ring, pry the bead away from it so that you can see between the two. Thus it will not be damaged and you can be sure there is no trapped air.

5. Never let a man use defective tools, lest they gouge the tire and the tools themselves. If using power tools, be sure they are seated properly before applying pressure. When mounting a tire, the use of sharp tools can rip the tube, necessitating its repair.

6. When inflating a tire, never face it directly, and where there are locking rings, watch out. If it has such a ring, face the ring against the wall or floor. Then inspect carefully as the air begins to enter to make sure that the ring is fitting properly before letting in more air. There is danger that any old, badly worn or damaged tire may blow up in one's face.

The Second Session

S. H. Ash, chief of the Bureau of Mines Safety Division, inquired into falls of ground in metal mines. These kill more men than any other cause. Of 81,000 men engaged in hard-rock mining in 1944 and who worked 186,000,000 man-hours, 144 were killed and 10,200 injured. How to prevent the falls is the problem. No sensational publicity attends falls of ground, which account for half the accidents, whereas gas explosions in coal mines are widely publicized, although they are responsible for only 7 percent of the accidents.

F. J. Haller, superintendent of Cleveland-Cliff's Mather mine, at Ishpeming, Mich., discussed "Safety in Sub-Level Stoping," showing with slides how practice with this method has improved since electrically operated scraping was introduced. Further improvement is sought.

"Training in an Iron Ore Mine" was the topic of H. J. Gemuenden, training director for Montreal Mining Co., Montreal, Wis. Advantages of working as a miner in the Lake Superior district iron mines outweigh the disadvantages, and it is up to the operator to make the miner see it, he said; hence the need for training. To accomplish this, the new employee must be properly oriented and made to realize, in part with the help of exhibits, that mining is a skilled craft and a desirable job, and that only by getting a good rating at each job level can he attain the level of job craftsman.

Detailed breakdowns of all jobs must be made and patterns formulated for instruction, thus establishing standards for the work. The supervisory force must likewise be trained in their jobs of trainers and imbued with the idea that they are trainers. They must formulate the patterns and see that they are carried out. The company's program might be called a plan for training through orderly leadership. To be effective, the training must be conducted and motivated by the supervisory staff.

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CONVEYORS
PUT ON
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Some experimental work done in a non-operating Butte mine to determine the effects of increased ventilation on dust concentration was described in a paper prepared by A. J. Richardson, ventilation engineer for Anaconda Copper Mining Co. This was presented by J. W. Warren, assistant ventilating engineer.

A Panel Discussion

At the closing session, after presentation of a paper by S. J. Mahon, safety supervisor for M. A. Hanna Co. at Hibbing, which reviewed mine accidents in the Lake Superior district in the last five years, the customary panel discussion of the fundamental causes of accidents ensued. Accidents were described from the floor, each then being analyzed by the panel members in the effort to fix the blame. Panel members included E. A. Anderson, Pickands, Mather & Co., chairman; G. G. Grieve, Mining Section, National Safety Council, Chicago; John Treweek, Homestake Mining Co., Lead, S. D.; A. R. McLeod, Oliver Mining Co., Virginia, Minn.; and Thomas Tippett, Cleveland-Cliffs Iron Co., Ishpeming, Mich.

Auxiliary to the meeting was an interesting exhibit of appliances devised to improve safety in both open-pit and underground operation.

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(*Continued from Page* 110)

mission to Japan in the early months of this year, I talked with a number of men about the return to the States, and asked the question, "What are you going to do after your release?" Most of the answers were "I don't know." Some expressed a desire to come back to the Orient, and only a few had definite jobs in the States which had been kept open for them.

To give the young fellows without jobs a better break, some new frontier will have to be opened up for them. For the sake of brevity I will mention only one possibility. That is the Island of New Guinea. The northwestern part is controlled by the Dutch; the southeastern area is under Australian mandate. Possibly some arrangements could be made between the United States and the Australian and Dutch governments, by which Americans might join them in the development of this new frontier, which is about 1,100 miles long, and, in places, up to 150 miles wide. It has every climate, from the tropics in the low lands around the coast to cold winters in the mountains, which range from 3,000 to 16,000 ft. in height. Only a few days ago a friend of mine flew over these mountains and told me they were all snow-capped.

The Japanese took New Guinea in 1942, and, according to an article in the *Nippon Times* in 1943, they had about a hundred experts review the commercial possibilities for private enterprise. As I remember, their reports were most favorable, and I made a few notes at the time. They stated that Japan would do more development in the next 30 years than the Dutch had done during the past 300. They also referred to the island as "the future treasure house of Japan." The reports mentioned:

First: The large timber reserves, which opened possibilities for the export of hardwoods, and the creation of a pulp and paper industry. Sawmills could be set up in a number of places to furnish lumber for building purposes, special lumber for plywood, mahogany for furniture, etc. Incidentally, before the war, one Japanese company operated a saw mill in Mindoro (P. I.), shipped the lumber to Japan, where it was converted into plywood, and then shipped it back to the Philippines for sale in Manila. Much timber would be needed for the construction of bridges, villages, towns, and cities in New Guinea, as well as for export.

Second: The experts pointed out the great possibilities in the fishing industry along the New Guinea Coast. This industry should employ thousands of men in the handling of boats, fishing, warehousing, canning, etc., all around the island.

Third: Agriculture. Comparatively speaking, a very small amount of food is raised in the low lands of New Guinea, and the ground in the altitudes has not been developed as yet for tea, grain, corn, fruit, etc. In the low lands, the rainfall is about 150 inches, and substantial crops of rice, coconuts, bananas, etc., could be raised, not only to support the island population, but also for export in helping the Orient get on a self-supporting basis.

Fourth: Mining. One of the finest placer gold mines in the world was developed by Canadian interests in the southern end of the island. This is the Bulolo Dredging Co., on the river of the same name, near Wau. Above Wau, at Edie Creek, I took part in the development of the New Guinea gold fields some years ago. Our company built the ports of Lae and Salamau.

I have talked with many of our boys who took part in the New Guinea campaign, and they spoke of crossing washes with gravel containing fine specks of gold, but as they added, "we were fighting a war, and not prospecting," and therefore had no time to test for commercial values.

One of the arguments frequently advanced against development in New Guinea is that "you can't get up in the hills because of the cannibals." We solved this problem at Edie Creek by giving the 800 natives we employed a change of diet—shipping in plenty of Australian lamb. It was simply a case of protein deficiency.

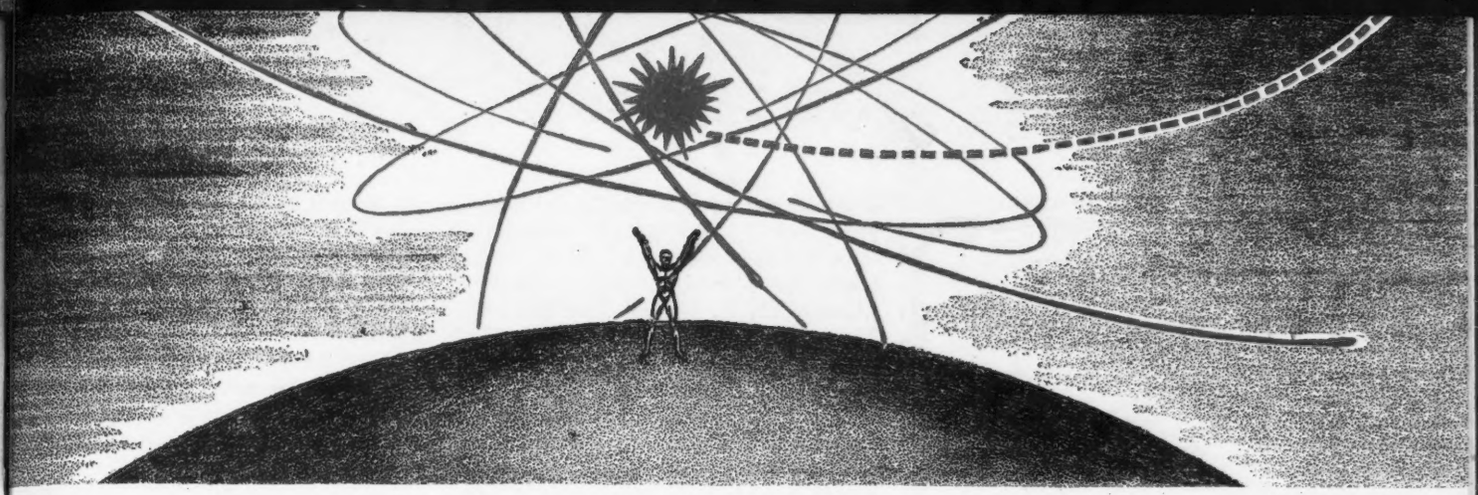
Dr. Otley Beyer, of the Bureau of Science of the Philippine Government, has shown me many times samples of jade from New Guinea. Something should be done to prospect the island for jade, precious metals, and other minerals. This is easily accomplished, because all that is necessary is to set up small offices at various points and offer bonuses to the natives for bringing in samples, with information as to where they were found. This is how the veins at Edie Creek were found.

America has the equipment, the capital, and enterprising men who know how to open up a country. During the last three years they built roads, bridges, wharfs, etc., not only in New Guinea, but in many other islands of the Pacific, in a manner undreamed of years ago. In New Guinea alone, this might run into a cost of hundreds of millions of dollars in opening up the jungle, so that the island can be properly developed.

If the Japanese had kept the island for the next 30 years, there is no doubt they would have developed and made a rich country out of it, where millions could prosper, just as they did in Manchuria during the past twelve years. America took the responsibility of putting the Japanese out, and returned the island to the Dutch and Australians, who are not in a position to finance and develop it, or even to maintain the roads built by our Army, or preserve the equipment left there.

In the event our young men should develop this new frontier, they should be given equal rights with the native, Australian, and Dutch inhabitants.

CHAS. A. MITKE,
Consulting mining engineer,
318 Ayala Building, Manila, P. I.



MAN vs ATOM—YEAR 1

WHEREIN WE SIGNALIZE THE FIRST ANNIVERSARY OF THE ATOMIC AGE, CONSIDER THE ALTERNATIVES INHERENT IN BOTH GOOD AND EVIL POTENTIALITIES OF NUCLEAR FISSION, THEN VENTURE A GLIMPSE INTO THE FUTURE

A YEAR AGO, July 16, 1945, at Alamogordo, New Mexico, man created the first atomic explosion. Most impressive events diminish in stature as they recede in time. This one grows bigger with each passing day. It truly marked the beginning of a new age.

As Year 1 of the Atomic Age ends and Year 2 begins, we are engaged in three portentous projects.

At Bikini Atoll we are detonating the fourth and, possibly, the fifth atomic explosions in the history of the world.

At Oak Ridge, Tennessee, we are building the first atomic energy plant for peaceful purposes.

Most important, in New York we and all the other United Nations are engaged in the first attempt to subject atomic energy to international control. Literally, the fate of the world hangs on this attempt.

As this introduction is written, the United Nations Atomic Energy Commission has just begun its work. People everywhere pray for its success—for their own sake, but even more for their children and for their grandchildren. If this Commission fails let everyone everywhere be warned: the world has taken a step toward destruction.

As we enter the second year of the Atomic Age, the nations of the earth are embarked on an atomic armaments race. There is no blinking that fact. We have had official notice served on us. Therefore, we must understand that unless the United Nations Commission can arrest the drift of events, we are moving toward a horrible war. The Commission must succeed.

The American delegate, Mr. Baruch, has brought to the Commission an ably thought out plan. It would internationalize nuclear science, and release for mankind the beneficent applications of atomic energy. But it would "control" atomic bombs only to the extent of giving the world brief warning of any nation's preparation to use them, so that we might have foreknowledge of disaster.

Therefore, the real and enormous task before the world becomes clear. We must end war. No other control of atomic weapons exists. If war comes, atomic weapons will be used. If they are used, our children who survive will curse their fathers. Understanding the consequences of failure, we *must* succeed.

Because we cannot succeed without knowledge, I have asked my associates at McGraw-Hill to condense into the following pages what we know at the close of Year 1 about this great new atomic force—its basic science, its possible uses and its political repercussions.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Co., Inc.

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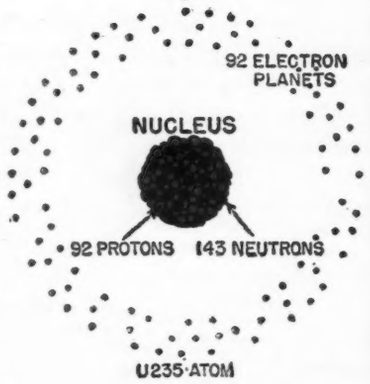
This Fateful Atom . . . c

1 ORE TO U235

Only 0.7% of natural uranium is U235

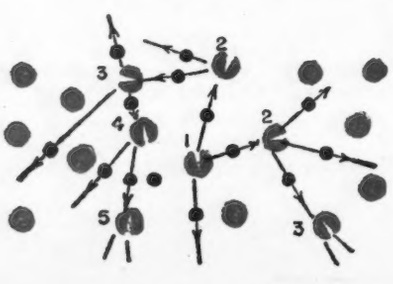
URANIUM ORE



U235 ATOM

2 CHAIN REACTION

Fragments from earlier nuclear explosions smash other nuclei



LOOKING BACK twelve months to the birth of Year 1, Atomic Age, we begin to sense the majestic import of the atomic bomb that blasted the naked desert at Alamogordo, N. M., on July 16, 1945. There man first shattered atoms in an explosive *fast-chain* reaction. Then came Hiroshima and Nagasaki.

In every case the fateful atom was either uranium 235 (U235), or plutonium derived from the action of U235 on U238. Every pound of U235 atoms split in these unprecedented blasts yielded the energy of 11.4 million kilowatt-hours, or 1400 tons of coal — slightly more for plutonium.

No matter where one mines uranium ore, the purified natural uranium (Fig. 1) always contains 99.3% of the "garden" variety U238, and a mere 0.7% of the precious U235.

An atom is like our solar system. The central sun is the nucleus — a bunched mass of protons and neutrons, each weighing one unit. The planets are electrons. Each proton has one plus electrical charge — each electron an equal negative charge. There must be as many negative electron planets as positive protons in the nucleus. This is also the "number" of the atom. Neutrons have no charge, but add weight.

The atomic number of uranium is 92 because the uranium atom always has 92 nuclear protons and 92 electron planets. The isotopes U238 and U235 differ only in the number of neutrons; U238 has 146 neutrons, and weighs 92 + 146 = 238 units. U235 has 143 neutrons, and weighs 92 + 143 = 235 units.

Ordinary chemical reactions, such as TNT explosions, release only a fraction of the modest energy of the whirling electrons in the outer atom. Nuclear reactions unlock the immensely greater energies which bind together the nucleus.

Even the gentle tap of a slow-moving neutron bullet will split the atom of U235 or of man-made plutonium into two medium-weight atoms, yielding also one to three spare neutrons plus energy. Thus these *fissionable* materials supply both their own bullets and a highly sensitive lot of high-explosive targets — a perfect setup for a *chain reaction* (Fig. 2).

Chain reactions work like chain letters. Neutrons from one nuclear explosion hit and explode other nuclei. But, since atoms are mostly open spaces a chain started in a small block of U235 or plutonium quickly dies out because most of the released neutrons escape from the block.

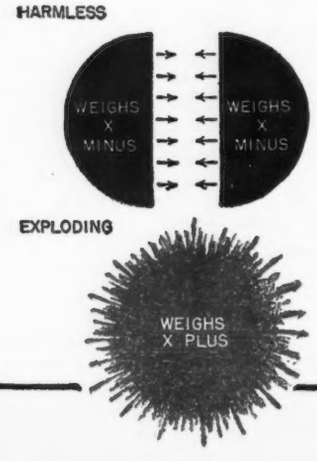
The bigger the block, the smaller will be the percentage of escaping neutrons, and the more left to split other nuclei. When the block is rapidly built up beyond a certain secret size the fragments of 1000 nuclear fissions split many more than 1000 additional nuclei. Then fissions multiply geometrically, and the block disintegrates with explosive speed and violence — as in a bomb (Fig. 3).

This bomb explosion is a fast-neutron chain. For economy and ease of control, uranium piles for the gradual release of nuclear energy for commercial purposes will normally use a lean fuel — that is U235 or plutonium diluted with U238, thorium or other less costly materials.

To maintain a chain reaction such piles must be large and artificially stimulated by using carbon blocks or some other *moderator* (Fig. 4) to slow many of the neutrons. Slow neutrons make more hits than fast neutrons because there is more time for them to be swerved from a straight path by the attraction of nearby nuclei, as shown below.

3 WHY BOMB EXPLODES

When block of rapidly assembled U235 passes secret critical size it explodes spontaneously



4 SLOW NEUTRONS MAKE MORE HITS

A slow neutron is more easily swerved from a straight line

...can Serve Man...

THE FATEFUL U235 ATOM can serve man as a new, compact source of heat energy for power generation, comfort heating or industrial processing. Peacetime applications of atomic energy will use dilute U235 or plutonium as a "fuel," mixed with carbon or some other moderator to slow some of the neutrons and thus keep the chain reaction going.

The diluting agent may be either U238 or thorium, or both. These will do double duty, because neutron bullets convert U238 into the energy-yielding plutonium, and thorium into U233, which may prove equally serviceable.

Thus the commercial piles of the future will "burn" U235 to make other atomic fuels, plutonium and possibly U233, which in turn will deliver heat energy to the pile. In that way it will be possible to get from the pile far more heat than the equivalent of 1400 tons of coal for each pound of U235 split. This highly attractive prospect will speed the day when nuclear energy can compete with coal.

While already mechanically obsolete, the piles making plutonium for bombs at Hanford, Wash. (Fig. 1) reveal the basic principle on which future piles for power and heat will operate. The heat now wasted in vast quantities will be put to work. The plutonium, now removed for bomb manufacture, will be returned to the pile (or left in) as supplementary fuel.

ATOMIC POWER

The possible everyday applications of nuclear heat pictured in Fig. 2 have been recognized from the very first day of the Atomic Age. Year 2 will see the building of the world's first atomic power plant (a pilot plant) at Oak Ridge, Tenn.

Beyond question such installations will produce power, but it may be years or decades before they prove economical. To compete with conventional plants the piles must first be redesigned to run at temperatures high enough for good power-plant efficiency. Also the techniques of operating piles by remote control through the heavy radiation screens must be radically streamlined.

The Hanford piles run on natural uranium containing only 0.7% of U235. The typical commercial atomic power plant of the future will use more than 0.7% of U235 or plutonium, but less than 50%. This will avoid both the low efficiency of the too-lean mixture and the excessive fuel cost of the rich mixture. It will permit piles of moderate size and take maximum advantage of U238 and thorium as potential sources of plutonium and U233.

One should not expect U235 to replace coal generally in this generation, although a few central power stations and ships will try it out before Year 10 of the Atomic Age. Plants far from traditional sources of fuels may turn much sooner to uranium and thorium as concentrated heat sources, that may easily be transported even to remote corners of the earth.

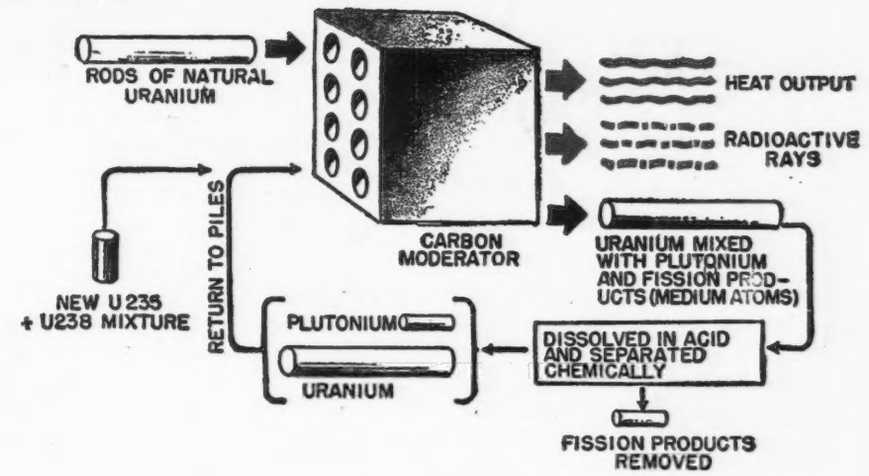
Atomic power, in forms now known, is impracticable for automobiles and small airplanes, because of the large initial investment in uranium and the need to carry 50 tons of shielding to protect riders and pedestrians against the deadly radioactivity accompanying nuclear fission.

RADIOACTIVE ISOTOPES

More immediately important than the heat and power applications of nuclear energy are the services that the radioactive byproducts of pile operation can render. Because these materials act chemically like their ordinary non-radioactive cousins, but can be followed and detected easily, they are expected to play tremendously vital parts in medicine and biology. For more details, see the last page of this section.

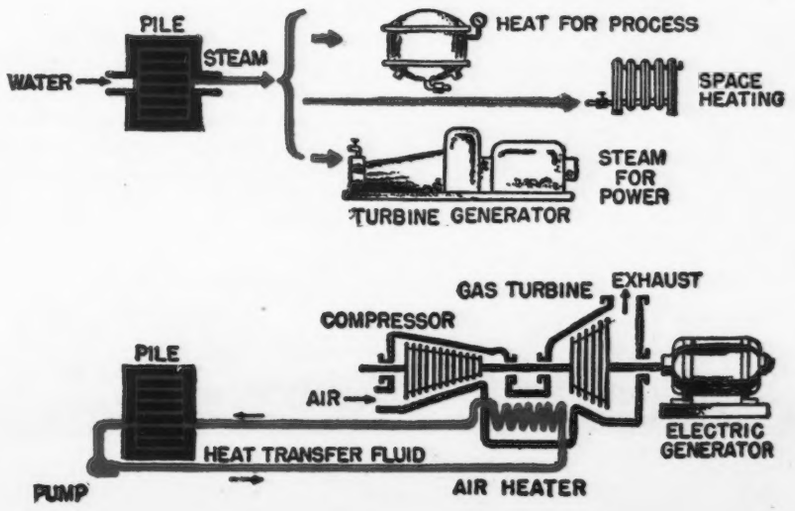
1 SLOW-NEUTRON PILE

Can make plutonium for bombs—or heat for power, process and comfort

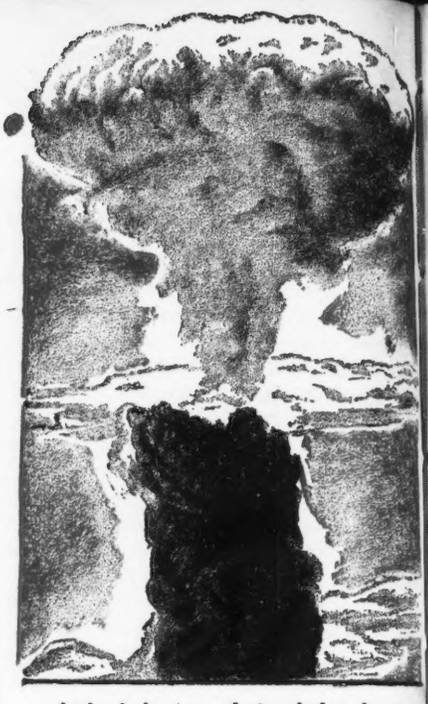


2 PRACTICAL APPLICATIONS

Include steam for turbines, process and comfort heating—also heat for gas turbines



or Destroy him . . .



A single improved atomic bomb can devastate ten square miles of city

URANIUM 235 and plutonium are now man's slaves. They will build or destroy as he orders. Man dreads this vast force only because he distrusts himself. War is proof that man in the mass has never achieved self-control. He has always sought better weapons; yet the perfect weapon now brings him no satisfaction for he sees in the atom bomb his own destruction as well as that of his enemy.

The ultimate benefits of nuclear energy may well surpass its present terrors, but the terrors are here now in awful dimension, and man must face them. He must pay this price for unlocking the wealth of the inner atom.

ATOMIC BOMB

This page, then, is about the atomic bomb. Nothing will be said here that is not either a certified scientific fact or a conclusion shared by the majority of the leading scientists, engineers and statesmen who have studied the matter.

As already explained, an explosive nuclear chain reaction spontaneously sweeps through a block of U235 or plutonium when the block is rapidly enlarged beyond a certain "critical" weight X. That weight is still a military secret; the official Smyth report vaguely suggests that it is more than 4 lb and less than 200 lb. Each piece of U235 in the dormant bomb must weigh less than X. At the desired instant of explosion the bomb mechanism assembles these pieces rapidly into a single piece considerably heavier than X.

The explosion itself drives the U235 pieces apart, thereby quenching the atomic conflagration before all the atoms are split, so the bomb efficiency is far less than 100%. For each pound of U235 (or plutonium) atoms actually split, the bomb releases the energy of 1400 tons of coal.

This explosion is mainly ordinary heat at work in unprecedented concentration. Bomb metals become incandescent vapor millions of degrees hot. This, and the enveloping sphere of glowing air, radiate a blinding flash that chars human flesh at half a mile and blisters at over a mile. There is a destructive shock wave (sound) and a second-long hurricane of unimaginable force — the outrushing of the expanding heated air. Deadly neutrons and gamma rays speed out from the bomb.

A single atomic bomb killed about 100,000 at Hiroshima. Fewer died at Nagasaki only because the circle of potential destruction included much vacant land. Bombs ten times more powerful can be made by the thousands in any major industrial country with the plants and the know-how. One bomb could saturate Minneapolis or downtown Manhattan.

Many experts estimate that a complete set of American atomic "secrets" and blueprints might save a foreign power two to three years at best in its race for atomic arms. With no help at all from us, any advanced industrial nation can, in five to ten years, acquire the raw materials, the plants, the know-how and enough bombs to knock out the big cities of any other country overnight. In Year 2 of the Atomic Age this arms race is already on.

It will not fail for lack of raw materials; every country has lean ores worth working for bombs.

There is no known defense against the atomic rocket attacking at mile-per-second speed

THE CHEAPEST DEATH

Cost need not deter, for the atomic bomb is by far the cheapest method of destruction ever devised. General H. H. Arnold estimates that atomic bombs can be manufactured *and delivered* for less than $500,000 per square mile of destruction.

Don't be misled by the two billion dollars America spent on a project that dropped only two bombs on the enemy. New plants can be built at a fraction of wartime cost, and the investment spread over thousands of bombs, not just two.

NO DEFENSE

So the bombs can be made in ample quantity and paid for, but can they be delivered? The answer is: "Yes; by the time the bombs are ready they can be delivered anywhere and overnight." If the defenses of the target country are weak, piloted planes can get through in ample number. Ten percent would be enough.

For more effective delivery radio-steered pilotless planes and rockets can carry the atom bombs faster than sound. Such weapons will be almost untouchable by either antiaircraft artillery or manflown fighters.

Greatest threat of all will be the transoceanic rockets. The German V-2 rocket, which never once was stopped by Britain's defenders, points one way. It needs only transatlantic range (with atomic propulsion) and an atomic bomb in the nose. Forty-six feet long, loaded with 7500 lb of alcohol fuel and 11,000 lb of liquid oxygen, the V-2 of World War II rose 60 miles in the air and arced 200 miles in five minutes to deposit one ton of TNT in London.

Seeing so many strange things come to pass, the man in the street cannot distinguish between possible miracles and the impossible variety. From the very start of the Atomic Age he has been hoping for a "ray" that will explode the atom bomb far off. Competent scientists and engineers say that cannot be.

The only way to bring down a 3500-mile-per-hour rocket at a safe distance is to chase it with your own 4000-mph rocket. You can't win at this game often enough to establish ironclad protection.

The only specific defense against the atomic rocket known in Year 2 of the Atomic Age is to disperse all cities and put key industries underground. This would be very costly in time, money and national morale.

MORE AND BETTER BOMBS?

Some will ask whether the U.S., as the most powerful industrial nation, could not build more and better bombs and carriers than any other nation. Probably yes, but there is still no real security. If the "weak" opponent has enough atomic weapons to destroy us once, what advantage is there in being able to destroy him twice?

Shooting first could protect us now, but not after the world is atomically armed. If we were to destroy the enemy's cities, we would probably miss his well-concealed and protected bomb magazines and rocket launchers. A few minutes later he could return the atomic fire. In brutal simplicity, that is the picture of future atomic war. Everybody loses.

At this point one grasps at another straw: "If everybody is to lose who would be so foolish as to start an atomic war? And didn't the Germans refrain from using gas for a similar reason?" Possibly yes. It *may* work that way. But in a world atomically armed to the teeth some nervous finger *may* pull the fatal trigger.

ONLY ONE WAY OUT

Throughout history each new offensive weapon has called out its appropriate defense. But now the offense leaps centuries ahead in a single bound and the defense lies almost helpless everywhere, unless some technical protection, unknown as Year 2 begins, can be devised.

The situation is extremely dangerous. There is no clear way out except through some sort of international action first to stop the atomic arms race and, before it is too late, to hobble war itself.

Can it be done? Perhaps not, but there is no alternative except atomic chaos.

...so he faces the Atomic Dilemma...

THE NUMBERED statements that follow in somewhat logical pattern are too fateful to be accepted on anybody's say-so. Every reader should test them in the light of his own information and understanding.

The points below sum up the conclusions of the previous article — and these in turn reflect a great mass of thought and discussion among leading scientists, engineers and statesmen close to the problem. To an amazing degree they concur on both facts and conclusions. For authoritative statements of their line of thought, in detail not possible here, the reader should see the recent book, *One World or None.*

THE DILEMMA

Nations must either face the probability of an atomic World War III, which would surely be the most deadly in history . . .

***Or*, the experts propose, yield both atomic weapons and war potential to international authority backed by superior force.**

What the Experts Say

1. In five to ten years any major industrial nation can make enough atom bombs to destroy all the major cities of any other country overnight.

2. This assumes no "secret" information or other help from us.

3. The necessary uranium ores will be at hand.

4. The cost will not be too high.

5. The bombs produced can then be carried thousands of miles by bombers, or by atomically powered guided missiles moving faster than sound.

6. There will probably be no effective military defense against such weapons.

7. Dispersing cities, and putting key industries deep underground, will give some protection if accomplished in time, but at incredible cost in money and human discomfort.

8. In a world atomically armed, nations can probably protect their bomb stocks and rocket launchers from enemy assault.

9. If so, nation A can destroy the cities of any other nation B, after which B's rockets will destroy the cities of A. Shooting first will not win an atomic war.

10. This knowledge may not restrain the trigger finger of a suspicious power.

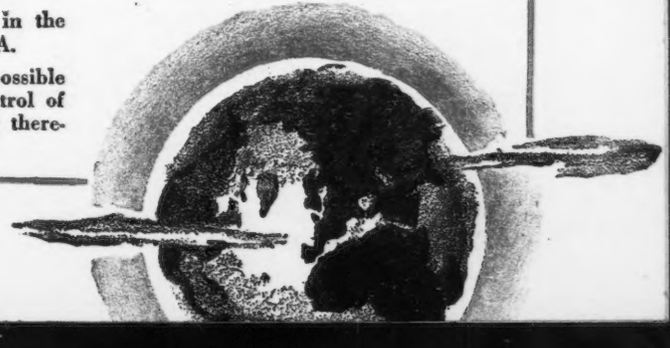
11. Having more and better atomic weapons than the other fellow won't help much if he has enough to destroy us. No use to kill a man twice or rebomb urban ruins.

12. Every nation is vulnerable in the Atomic Age, including the U. S. A.

13. National security will be impossible without (first) international control of atomic arms and (not too long thereafter) international control of all war potential, both backed by superior physical power.

14. If action to this end is long delayed, it may become impossible to halt the atomic arms race already started.

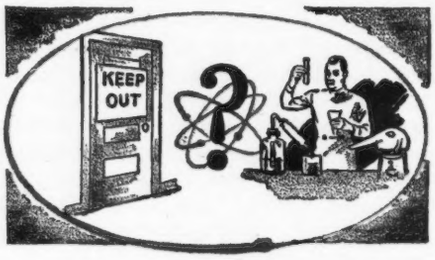
15. At best, the necessary degree of international control, with some real delegation of national sovereignty, will be a revolution in human affairs. It may prove to be humanly unobtainable at this time. If so, men and women everywhere must face the probability of an atomic third world war—by far the most destructive in all history.



In this atomic age no nation can be safe through its own unaided might

...and the Great Debate unfolds

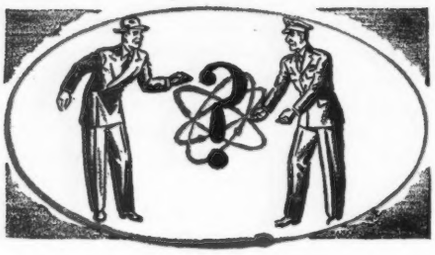
ATOM YEAR 1 has probably been marked by more debate on a single subject than any other twelve months in the world's history. Social, economic and political as well as purely technical issues have been pressing for realistic solution. Let us look at these issues and see where we stand:



SECRECY VS. FREE SCIENCE

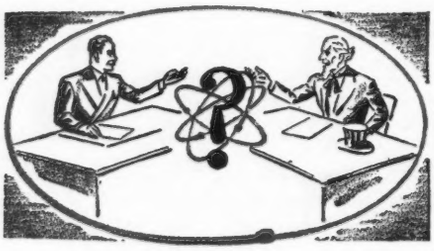
Throughout the first year of the Atomic Age hot debate has raged around "keeping the secret of the bomb." To prevent potential enemies from making atom bombs some have urged a complete blackout of all phases of atomic energy — even of the scientific fundamentals of nuclear physics. Others have sought immediate and complete disclosure of all bomb "secrets," both scientific and technological. These have held that such information cannot be effectively hidden, that secrecy blocks progress and breeds wars.

A year of debate has brought the great mass of vocal opinion to this middle ground: (1) Ease restrictions on the exchange of basic physical knowledge. (2) Release for industry's benefit many of the devices and methods developed for the bomb project. (3) Hold tight to specialized information on atomic bombs and bomb-material production until international safeguards are fully operative.



CIVILIAN VS. MILITARY

Because the atomic bomb is the world's greatest weapon, the armed forces would like to control it. But because atomic energy can also be used for peaceful, beneficial purposes, civilian control seems equally essential. These conflicting viewpoints had their strong proponents before the Congress which finally reached a fairly satisfactory compromise in the Atomic Energy Bill of 1946, setting up a competent civil board with which the armed forces will have continuing liaison. As we go to press, just before Year 2 of the Atomic Age begins, this bill has passed the Senate, but there is still a question how rapidly it will be enacted into law.



PRIVATE VS. PUBLIC

Atomic energy is "too big" and "too hot" to be handled privately. It must be nationalized and internationalized. The questions are *how* and *to what extent.* Fortunately, as the "boxes" on these pages show, there are means that may attain reasonable safety against misuse of the atom, and still do so without public control of many "non-dangerous" applications.

DOMESTIC CONTROL AS PLANNED IN THE ATOMIC ENERGY BILL OF 1946

McMahon Committee Bill contains the following provisions.

Policy. Declares it the policy of the U. S. to develop and utilize atomic energy to improve the public welfare, increase living standards, strengthen competitive enterprise and promote world peace.

Organization. Establishes the Atomic Energy Commission (AEC) of five administrators to direct four divisions on research, production, engineering, and military applications—to work in liaison with three committees from (1) the armed forces, (2) outstanding civilians, and (3) joint Congressional representatives.

Production. AEC to own and operate (under management contracts with industry if deemed desirable) all facilities for the production of fissionable materials, such products to be distributed with their radioactive byproducts under license for private industrial and medical research.

Military Application. AEC to engage in development work and produce atomic bombs as directed by the President, to be delivered only on his order to the Armed Forces.

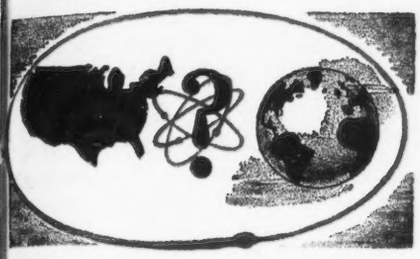
Industrial Utilization. Permits AEC to conduct research, design and manufacture equipment for atomic-energy utilization, license its use, produce and sell power obtained as a byproduct in the production of fissionable materials. Directs AEC to give widest safe scope to private initiative.

Control of Information. AEC to enforce a ban on the dissemination of restricted data that might be used to injure the U. S. or secure advantage to a foreign nation, yet to provide leeway for ultimately relaxing restrictions as future conditions warrant.

Patents and Inventions. No private patents permitted for production of fissionable materials or their utilization for military weapons, but AEC will justly compensate for such inventions, when made by private citizens. Patents for non-military applications may be purchased or condemned by the AEC only when public interest is affected.

Appropriations. "Such sums as may be necessary and appropriate to carry out the purposes and provisions of the act" *plus* unexpended funds of the Manhattan Engineer District.

...while Time runs out



NATIONAL VS. INTERNATIONAL

Born of nationalism, the Atomic Age began when three nations discovered a weapon that today gives them the greatest military power on earth. The prime question is: Shall the atom remain the servant of its conqueror, nationalism?

During Year 1 of the Atomic Age the Truman-Atlee-King declaration, the masterly report of the State Department's atomic consultants, and the U.S. representative on the United Nations Atomic Energy Commission, have all called for international control of atomic energy. Year 2 will start with no such control. This failure to decide and act is in part a natural result of the extreme difficulty of the problem and the obvious dangers of unwise decisions. Nations everywhere face a triple dilemma in this Atomic Year 2: the dangers of nationalism, the dangers of internationalism, the supreme danger of not being able to make any decision in time to meet the atomic bomb threat.

INTERNATIONAL CONTROL AS PROPOSED BY THE U.S. TO U.N. ATOMIC COMMISSION

Baruch statement follows constructive path laid out by Atomic Consultants in "Acheson-Lilienthal Report."

The Plan. The U.S. has proposed that all nations band together to outlaw the use of atomic energy for war and to promote and harness its development for the benefit of mankind. To this end an International Atomic Development Authority would be set up, and to it the U.S. would turn over, at various stages of its organization, all atomic bombs, know-how, raw materials, facilities, and stockpiles of fissionable material. Thus IADA eventually would supersede national authorities on some matters and supplement them on others.

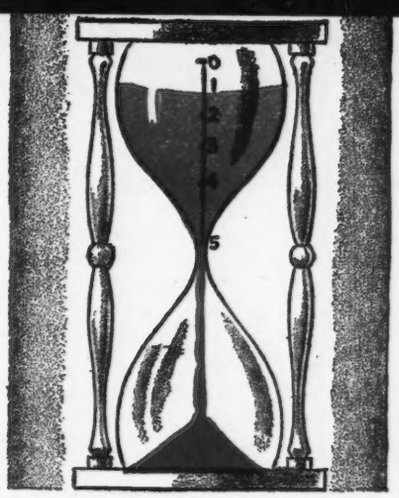
Owner and Operator. IADA would take over from national authorities or private ownership full management and control of all atomic energy matters that afford a possible threat to World security. These include:

1. Raw Materials—Supplies of uranium and thorium to be inventoried, controlled, and developed by IADA.
2. Facilities—IADA to control and operate plants producing fissionable materials and to own and control their products.
3. Research—IADA to undertake research and development on all aspects of atomic energy and to possess exclusive right of research on atomic explosives.

Private Initiative. Will have its chance to push forward the use of atomic energy for peacetime (non-dangerous) purposes. With IADA providing raw materials and carrying out necessary inspection, national and private enterprise may operate "safe" power piles, and produce and use radioactive isotopes for research, clinical and other applications. Radioactive isotopes produced by IADA also can be distributed for peacetime use.

The Mechanics of Safety. No plan is a certain guarantee against future atomic war. This plan should, however, prevent surprise attack with atomic weapons; for IADA is to buttress positive ownership or management controls with wide powers of inspection. Obviously, successful inspection rests on complete freedom of access or egress in any area.

Sanctions. At the heart of the plan lies the problem of penalty for violation — a matter for profound statecraft. To the U.S., one aspect of sanctions appears crystal clear: Here is an area where the veto right now held by the five great Powers must be redefined if it is not to be incompatible with the meaning and purpose of the proposed control.



Leading industrial nations can produce atomic bombs in five years, competent scientists announced after Hiroshima. Already one year of the precious five has been consumed in debate without international action. Soon it may be too late to check the growing momentum of the atomic arms race.

TIMETABLE—ATOM YEAR 1

1. **July 16, 1945.** World's first atomic bomb detonated in New Mexico.
2. **July 26, 1945.** President Truman and Prime Minister Churchill issue Potsdam ultimatum threatening Japan's destruction if she continues.
3. **August 6, 1945.** Atomic bomb dropped on Hiroshima.
4. **August 9, 1945.** Atomic bomb hits Nagasaki.
5. **August 11, 1945.** Army releases Smyth Report on "Atomic Energy for Military Purposes."
6. **August 14, 1945.** Japan accepts terms of Potsdam declaration.
7. **November 15, 1945.** Truman-Atlee-King issue declaration of intention and procedures looking toward international control of atomic energy by United Nations.
8. **March 28, 1946.** State Department issues Acheson-Lilienthal Report on the "International Control of Atomic Energy."
9. **April 12, 1946.** Manhattan Engineer District announces program for experimental development of atomic power.
10. **June 1, 1946.** "Atomic Energy Bill of 1946" passes Senate unanimously, is referred to House of Representatives.
11. **June 14, 1946.** First meeting of United Nations Atomic Energy Commission (Bernard Baruch as American member). Manhattan District announces availability of radioactive isotopes for research use.
12. **July 1946.** Joint Army-Navy tests of atomic bombs at Bikini.

...but if Man Masters Atom

IF MUTUAL DESTRUCTION by the atomic bomb can be avoided, the first century of the atomic age will bring immense advances in scientific knowledge, health and living standards. Already many prospective benefits can be outlined, but those we can neither foresee nor suspect may be even more important.

This prediction is grounded in scientific experience; the most fundamental discoveries have always been the most fruitful. The study of molecules gave us chemistry. Faraday's experiments with electricity and magnetism are the foundation stones of the great electrical industry. Can one expect any less from an understanding of the heart of every atom?

BENEFITS

Atom-splitting benefits clearly visible today fall mainly in three classes: (1) heat and power applications of the uranium piles; (2) general industrial applications of equipment and methods originally developed for the bomb project; (3) chemical, biological and medical uses of the "tagged atoms" (radioactive isotopes) now abundantly available from pile operation.

It is now evident that the energy yield of the U235 in an atomic pile can be multiplied many times by returning to (or leaving in) the pile the plutonium and possibly the U233 produced respectively from the U238 and the thorium in the pile. This is an indirect way to "burn" inexpensive U238 and thorium, and thus greatly extend the supply and reduce the cost of atomic fuels.

POWER APPLICATIONS

Although present piles run at low temperatures, it is certain that temperatures high enough for the efficient operation of steam and gas turbines will be attained. Already an experimental atomic power plant has been ordered. Atomic power for certain remote installations (say, for heating Arctic airports) may not be far off.

In five or ten years uranium piles will be driving a few experimental ships and submarines. In 20 or 30 years uranium may begin to compete widely with coal as a fuel for suitably situated large central heating and power plants. The 50-ton minimum weight of shielding rules out nuclear power for automobiles and small piloted planes.

SPECIAL USES

Some day ultra-high temperatures from splitting atoms will be used for special industrial operations on metals and other materials. Even the dread atomic bomb might easily serve peaceful ends — blasting lakes in deserts, changing the course of rivers, leveling mountains.

INDUSTRIAL BYPRODUCTS

The special industrial equipment and methods developed for the bomb project will find hundreds of important uses — mostly for purposes unrelated to atomic energy. These developments include pumps with neither seals nor leaks, leak detectors of amazing sensitivity, ultratight welding, a portable mass spectograph for quick and automatic gas analysis, new ways of handling corrosive and poisonous materials, new diffusion barriers for the separation of gases and of petroleum products.

TAGGED ATOMS

Yet more important than any of these, in the long run, will be the hundreds of radioactive isotopes now available as by-products of pile operation. Chemically indistinguishable from the ordinary forms of the elements, these isotopes serve as tagged atoms or "spies" if mixed with common stable atoms of the same species. They "fly with the flock," and can later be identified as surely as banded birds. With these amazing tools of research, the course of any element or compound may be traced through the bodies of men, animals and plants. Similarly, tagged atoms may be used in studying the course of many kinds of industrial and chemical operations.

BIOLOGY AND MEDICINE

A suspected hyperthyroid condition can be diagnosed by feeding the patient a minute measured amount of radioactive iodine. The click of a "Geiger" counter placed on the patient's neck will tell (1) what percentage of the swallowed iodine concentrates in the thyroid cells and (2) how rapidly that concentration is accomplished — giving a definite indication of the state of the gland.

In similar fashion the radioactive isotopes of hydrogen, oxygen and carbon will trace out the intricate transformations of carbohydrates and proteins in the human body. Radioactive phosphorus will explore the bones. Radioactive iron will show how and where blood cells are formed. Radioactive sodium will time the circulation of blood.

USES IN INDUSTRY

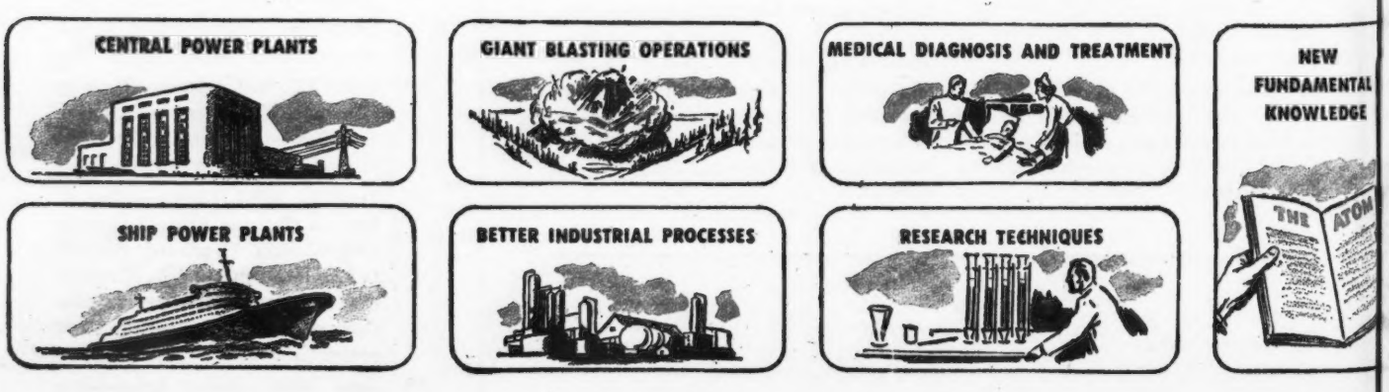
In chemistry the radioactive isotopes will speed the understanding of metallurgical and organic reactions. In industry they will measure flow, detect leaks, and do other useful work.

Meanwhile the uranium piles will be manufacturing certain radioactive isotopes that can serve as cheap but effective substitutes for high-cost medical radium.

KNOWLEDGE COMES FIRST

It is already clear that the chief benefits of atom splitting will come first as new scientific knowledge rather than as new engines and gadgets. But in the long run man's new understanding of the inner atom will enrich the whole range of human activity. This has always been the case with less fundamental discoveries in science. It can hardly be less with this most fundamental discovery.

ATOM SPLITTING WILL SERVE MAN IN:



ENGINEERING AND MINING JOURNAL

AUGUST, 1946

Time for a Change of Pace

TO THOSE OF US WHO ASPIRE to serve the mining industry faithfully and well, and to help it serve itself and the public better, there have been numerous occasions for regret during the past several years over the extent to which the industry has been affected by events and policies in the formulation of which it has had no real part.

In some of the broad national policies established during the last 15 years, such as the Reciprocal Trade program, revenue laws, regulation of the sale of securities, and New Deal labor legislation, the mining industry has been only one among large groups of people affected, and any amount of protest on its part probably would not have changed the broad lines of history. Nevertheless, in all of these issues certain features directly related to mines or minerals might have been solved more realistically had the mining industry been present in the formative stages with positive, informed suggestions, reasonable unanimity, and active grass-roots support.

In other developments dealing directly with mining, details of the Premium-Quota plan, the wartime gold-mine closing order, L-208, and projects now in the formative stage hinging upon our alleged "have-not" status in minerals, policies affecting mining primarily were or are being established without industry approval and with an unrealistic conception of the consequences. To a considerable extent the outcome is not to the industry's liking because the industry was not on the field in force when the battle was fought and turned up only to fight a rear-guard action after the outcome was decided.

These were collective problems. Their solution called for intelligent collective action. Moreover, in the field of technical progress, and in better handling of the mining industry's internal problems, advances being made by others suggest that we can profit by pooling our problems and brains more effectively.

The mining industry, by and large, is a group of individualists cherishing a great tradition of rugged individualism. Probably this is why we have not done too well along collective lines. The virtues of individualism are too obvious and too interwoven with the fabric of our national greatness to require elaboration here. We simply wish to point out that it is possible to pool our efforts in certain directions to mutual advantage without destroying the precious values in our individualistic traditions. We can, in short, cherish but harness our individualism, in order to increase its usefulness, just as a man must do to become socially effective.

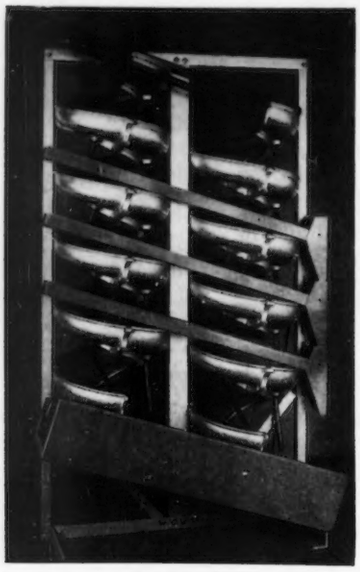
To this end, and to enable the mining industry to meet its future problems competently, we offer herewith a plan of action. It is presented, not in a spirit of criticism, but with an earnest desire to help advance the industry's well-being. Possibly others can improve on our suggestions, but at least here is "something to shoot at." The ideas contained herein are not highly original but are adapted from successful procedures elsewhere which our editors have had the opportunity to observe. Thus, we contend that they are workable—not ivory-tower dreams.

No doubt it will seem to some as though such a frank airing of mining problems will give aid and comfort to enemies of the industry. In answer to any such accusations, we reply that the industry has very few real enemies. Most of those who appear in that light are simply ignorant of mining's economy. The maneuvers of any real enemies are better met by cleaning our own house than by a purely reactionary attitude which allows defects to accumulate until outsiders take the initiative out of our hands.

Our proposals involve a lot of additional work and some expense by members of the industry. However, the problems are there, and in one way or another are costing more effort and expense than will be required for their solution. Most of these problems are collective, and call for collective treatment. There is no "other way" unless we are willing to tolerate the status of being hauled through one issue after another with our feet dragging, and with no real voice in determining the direction in which we are being taken.

In short, our choice is a simple one. Will we meet modern problems according to a modern concept of industry responsibility, or will we continue to lose battles by default and content ourselves with guerrilla warfare?

HUMPHREYS
SPIRAL CONCENTRATOR



LOW COST OF INSTALLATION
NO MOVING PARTS
LOW OPERATING COST

Engineering Division
The Humphreys Investment Co.
First National Bank Building
DENVER 2, COLORADO

HOLD IT!

Take Time to

Walk All Around

A PROBLEM

Before Making a Decision

ORE TESTING
PLANT DESIGNING
PLANT OPERATION

ASSOCIATED ENGINEERS
BOOTH ENGINEERS
F. C. TORKELSON CO.
PACIFIC NATIONAL LIFE BLDG.
SALT LAKE CITY 1, UTAH

Lake Superior Meeting

(*Continued from Page* 139)

road should be driven on. All trucks drive from the left, and left-side driving would appear to offer maximum advantage. Signs could be used at the pit entrance to avoid confusion.

Accidents when a man is injured by being run into usually show carelessness, and can be prevented. A horn signal to be used before starting should reduce the hazard.

Spinning steering wheels are responsible for the largest single group of lost-time accidents, 13 percent of the total of recorded cases being thus caused. The remedy is power-steering. Such accidents are definitely preventable.

Twenty accidents were due to falling dirt, near the truck. Six were due to slides of frozen dirt while cleaning truck boxes; five to rocks striking dumpmen while dumping; and nine to dirt falling from dipper or box while loading. Aside from the box-cleaning accidents, the others are preventable. The driver should stay on the truck while loading, or stand well away. With closed doors he is safe.

Summing up, Mr. Leach found that generally the most serious accidents are those caused by collisions and by trucks running off the road or over a bank or dump. Remedies include more and better training of operators, marking of the road with reflectors for night work, better lighting of roads and dumps, and care in selection of dump men and equipment operators, as well as of the equipment itself. Next in order are the accidents caused by vehicles running into employees other than those by whom the vehicles are driven. The remedy is more care by the men on the machines and those working around them and the use of warning signals when the machines are moved. Finally, accidents from spinning steering wheels can be avoided by use of steering boosters.

Maintenance and Safety in Truck Haulage

Charles A. Lindberg, supervisor of truck maintenance at Virginia, on the Mesabi, for Oliver Iron Mining Co., discussing the maintenance phase of safe truck haulage, considered it in its broadest aspect, including the field and shop sides of the problem.

Heavy-duty trucking of iron ore really began in 1937, when Butler Brothers started with three 15-ton trucks on the Cuyuna Range and the Oliver company purchased four 20-ton units for use at the Spruce mine, on the Mesabi. In 1945, half of the tonnage of ore shipped was moved at the mines by truck, or 32,731,000 tons, and 68 percent of the stripping, or 34,586,000 tons. Of the grand total of 116,013,000 tons of all materials shipped or moved in the area last year, 58 percent was handled by truck. To move this tonnage 700 trucks were required.

Trucking accidents increased more slowly than did the use of trucks, amounting to 17 percent of all time-losing accidents for the nine years 1937-1945. In round figures the record is one accident for 1,005,000 tons in 1945, compared with one accident for 389,000 tons in 1937. Four of the fatalities, it seems, could have been averted by a warning horn or signal used each time the vehicle was moved. The record indicates the importance of maintaining such accessories, including also rear-view mirrors, windshield wipers, stop lights, and back-up lights. For pushing or turning jobs in the pit or around the garages, Mr. Lindberg recommended the use of rigid tow bars and proper hooks or towing hitches on the front and rear of each truck.

Equipment Heavier

Truck construction has trended to larger, heavier equipment, and existing equipment is being made heavier and provided with larger tires. Maintenance equipment, such as lifting tackle, jacks, and the like, must keep pace. New equipment should be selected with an eye to the future. According to 1945 records, 20 percent of the trucking accidents involved strains due to lifting or pushing. Many occurred while handling tires. Instruction should be given in correct ways of lifting.

Few accidents were caused by mechanical failure, the total being 8 out of 332 for the nine-year period. In these, all truck components that can contribute directly to accidents were represented—namely, front tires, front wheels, and steering, service, and emergency brakes, drive lines, and truck frames.

The tire safety record has been good. It is promised that postwar tire quality will be better than that of prewar tires. Hazards inherent in inflation of the tire have been met in various ways. For example, tires are placed in various steel cages while being inflated. Or the tire is inflated while flat on the floor with the lock ring down and with an inflation chuck clamped to the air valve. This valve and the pressure gage are on the wall at a safe distance. Rims and lock nuts must not be continued in service too long.

Power steering is gaining acceptance, as indicated by fewer accidents from jackknifing steering wheels in 1945. Old equipment can be readily converted.

Attention to Brakes

Increased attention to initial design and specifications for brakes give the operator a greater margin of safety in brake maintenance. The trend also provides increased storage and larger compressor capacities with improved control devices. An improved emergency service brake system can now be had as standard on new trucks.

Hand emergency brakes still offer a problem, the main difficulty being that

the driver fails to release them. A solution for this difficulty is to install a pull-type air valve in the linkage between the brake hand lever and the brake mechanism to take air from the main reservoir and feed it to the rear brakes. This gives a good parking brake but compels release of the emergency brake before the truck can move. The emergency brake must still be kept in good condition to hold the truck standing when there is no air pressure.

Brake maintenance should have additional reserve to be able to stop the truck if the drive lines fail, causing loss of the drag of engine and transmission and of use of the emergency brake. Means should be provided to limit movement of broken shafts, as with yokes or shaft tunnels, lest they cut air lines and thus destroy the braking system.

Recent engines using volatile fuels stored under pressure have brought in new hazards which appear to be well controlled.

Larger clutches, with air assists to lessen driver fatigue, and larger transmissions, have been necessitated by increased capacities of trucks and engines. Better designs of driver's seat and better location of controls have also received attention. These changes promote efficiency and safety.

Hoists are not a safety problem save where they are inadequate. Frame design and materials are receiving much attention.

Two schools of thought exist as to truck maintenance. According to one, the truck finally selected is overhauled regularly at stated times. According to the other it is allowed to run to its practical limit, with mainteance keeping up with production.

Tires Important

Tires in respect to safe truck haulage were also discussed, the speaker being Fred O. Kittell, manager of the tire department, Malkerson Service, Minneapolis. After briefly describing the materials used in tires, he pointed out that each manufacturer makes a number of tread styles, each for a definite place and application. These include traction treads, shallow treads, and free-rolling treads. Used properly these will give the truck the safest footing possible.

In handling tires, one should bear in mind that a tire is like a high-pressure boiler that has never had to pass a Hartford or state inspection for safety. Mr. Kittell outlined the following procedure:

1. Remove the valve core by hand or by tool, before handling. Every tire must be completely deflated before anyone works on it.

2. Before using tools, find out the recommendations of tire makers and tool manufacturers regarding the procedure to be followed.

3. If the lug nuts are badly frozen, don't try to break them loose with an oversize wrench, but first use a penetrating oil as a persuader, plus a few taps on each nut as pressure is applied.

4. Before removing the locking ring, pry the bead away from it so that you can see between the two. Thus it will not be damaged and you can be sure there is no trapped air.

5. Never let a man use defective tools, lest they gouge the tire and the tools themselves. If using power tools, be sure they are seated properly before applying pressure. When mounting a tire, the use of sharp tools can rip the tube, necessitating its repair.

6. When inflating a tire, never face it directly, and where there are locking rings, watch out. If it has such a ring, face the ring against the wall or floor. Then inspect carefully as the air begins to enter to make sure that the ring is fitting properly before letting in more air. There is danger that any old, badly worn or damaged tire may blow up in one's face.

The Second Session

S. H. Ash, chief of the Bureau of Mines Safety Division, inquired into falls of ground in metal mines. These kill more men than any other cause. Of 81,000 men engaged in hard-rock mining in 1944 and who worked 186,000,000 man-hours, 144 were killed and 10,200 injured. How to prevent the falls is the problem. No sensational publicity attends falls of ground, which account for half the accidents, whereas gas explosions in coal mines are widely publicized, although they are responsible for only 7 percent of the accidents.

F. J. Haller, superintendent of Cleveland-Cliff's Mather mine, at Ishpeming, Mich., discussed "Safety in Sub-Level Stoping," showing with slides how practice with this method has improved since electrically operated scraping was introduced. Further improvement is sought.

"Training in an Iron Ore Mine" was the topic of H. J. Gemuenden, training director for Montreal Mining Co., Montreal, Wis. Advantages of working as a miner in the Lake Superior district iron mines outweigh the disadvantages, and it is up to the operator to make the miner see it, he said; hence the need for training. To accomplish this, the new employee must be properly oriented and made to realize, in part with the help of exhibits, that mining is a skilled craft and a desirable job, and that only by getting a good rating at each job level can he attain the level of job craftsman.

Detailed breakdowns of all jobs must be made and patterns formulated for instruction, thus establishing standards for the work. The supervisory force must likewise be trained in their jobs of trainers and imbued with the idea that they are trainers. They must formulate the patterns and see that they are carried out. The company's program might be called a plan for training through orderly leadership. To be effective, the training must be conducted and motivated by the supervisory staff.

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Some experimental work done in a non-operating Butte mine to determine the effects of increased ventilation on dust concentration was described in a paper prepared by A. J. Richardson, ventilation engineer for Anaconda Copper Mining Co. This was presented by J. W. Warren, assistant ventilating engineer.

A Panel Discussion

At the closing session, after presentation of a paper by S. J. Mahon, safety supervisor for M. A. Hanna Co. at Hibbing, which reviewed mine accidents in the Lake Superior district in the last five years, the customary panel discussion of the fundamental causes of accidents ensued. Accidents were described from the floor, each then being analyzed by the panel members in the effort to fix the blame. Panel members included E. A. Anderson, Pickands, Mather & Co., chairman; G. G. Grieve, Mining Section, National Safety Council, Chicago; John Treweek, Homestake Mining Co., Lead, S. D.; A. R. McLeod, Oliver Mining Co., Virginia, Minn.; and Thomas Tippett, Cleveland-Cliffs Iron Co., Ishpeming, Mich.

Auxiliary to the meeting was an interesting exhibit of appliances devised to improve safety in both open-pit and underground operation.

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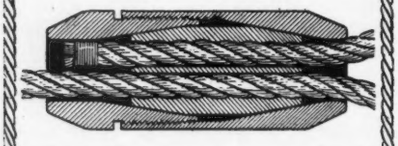

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(*Continued from Page* 110)

mission to Japan in the early months of this year, I talked with a number of men about the return to the States, and asked the question, "What are you going to do after your release?" Most of the answers were "I don't know." Some expressed a desire to come back to the Orient, and only a few had definite jobs in the States which had been kept open for them.

To give the young fellows without jobs a better break, some new frontier will have to be opened up for them. For the sake of brevity I will mention only one possibility. That is the Island of New Guinea. The northwestern part is controlled by the Dutch; the southeastern area is under Australian mandate. Possibly some arrangements could be made between the United States and the Australian and Dutch governments, by which Americans might join them in the development of this new frontier, which is about 1,100 miles long, and, in places, up to 150 miles wide. It has every climate, from the tropics in the low lands around the coast to cold winters in the mountains, which range from 3,000 to 16,000 ft. in height. Only a few days ago a friend of mine flew over these mountains and told me they were all snow-capped.

The Japanese took New Guinea in 1942, and, according to an article in the *Nippon Times* in 1943, they had about a hundred experts review the commercial possibilities for private enterprise. As I remember, their reports were most favorable, and I made a few notes at the time. They stated that Japan would do more development in the next 30 years than the Dutch had done during the past 300. They also referred to the island as "the future treasure house of Japan." The reports mentioned:

First: The large timber reserves, which opened possibilities for the export of hardwoods, and the creation of a pulp and paper industry. Sawmills could be set up in a number of places to furnish lumber for building purposes, special lumber for plywood, mahogany for furniture, etc. Incidentally, before the war, one Japanese company operated a saw mill in Mindoro (P. I.), shipped the lumber to Japan, where it was converted into plywood, and then shipped it back to the Philippines for sale in Manila. Much timber would be needed for the construction of bridges, villages, towns, and cities in New Guinea, as well as for export.

Second: The experts pointed out the great possibilities in the fishing industry along the New Guinea Coast. This industry should employ thousands of men in the handling of boats, fishing, warehousing, canning, etc., all around the island.

Third: Agriculture. Comparatively speaking, a very small amount of food is raised in the low lands of New Guinea, and the ground in the altitudes has not been developed as yet for tea, grain, corn, fruit, etc. In the low lands, the rainfall is about 150 inches, and substantial crops of rice, coconuts, bananas, etc., could be raised, not only to support the island population, but also for export in helping the Orient get on a self-supporting basis.

Fourth: Mining. One of the finest placer gold mines in the world was developed by Canadian interests in the southern end of the island. This is the Bulolo Dredging Co., on the river of the same name, near Wau. Above Wau, at Edie Creek, I took part in the development of the New Guinea gold fields some years ago. Our company built the ports of Lae and Salamau.

I have talked with many of our boys who took part in the New Guinea campaign, and they spoke of crossing washes with gravel containing fine specks of gold, but as they added, "we were fighting a war, and not prospecting," and therefore had no time to test for commercial values.

One of the arguments frequently advanced against development in New Guinea is that "you can't get up in the hills because of the cannibals." We solved this problem at Edie Creek by giving the 800 natives we employed a change of diet—shipping in plenty of Australian lamb. It was simply a case of protein deficiency.

Dr. Otley Beyer, of the Bureau of Science of the Philippine Government, has shown me many times samples of jade from New Guinea. Something should be done to prospect the island for jade, precious metals, and other minerals. This is easily accomplished, because all that is necessary is to set up small offices at various points and offer bonuses to the natives for bringing in samples, with information as to where they were found. This is how the veins at Edie Creek were found.

America has the equipment, the capital, and enterprising men who know how to open up a country. During the last three years they built roads, bridges, wharfs, etc., not only in New Guinea, but in many other islands of the Pacific, in a manner undreamed of years ago. In New Guinea alone, this might run into a cost of hundreds of millions of dollars in opening up the jungle, so that the island can be properly developed.

If the Japanese had kept the island for the next 30 years, there is no doubt they would have developed and made a rich country out of it, where millions could prosper, just as they did in Manchuria during the past twelve years. America took the responsibility of putting the Japanese out, and returned the island to the Dutch and Australians, who are not in a position to finance and develop it, or even to maintain the roads built by our Army, or preserve the equipment left there.

In the event our young men should develop this new frontier, they should be given equal rights with the native, Australian, and Dutch inhabitants.

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